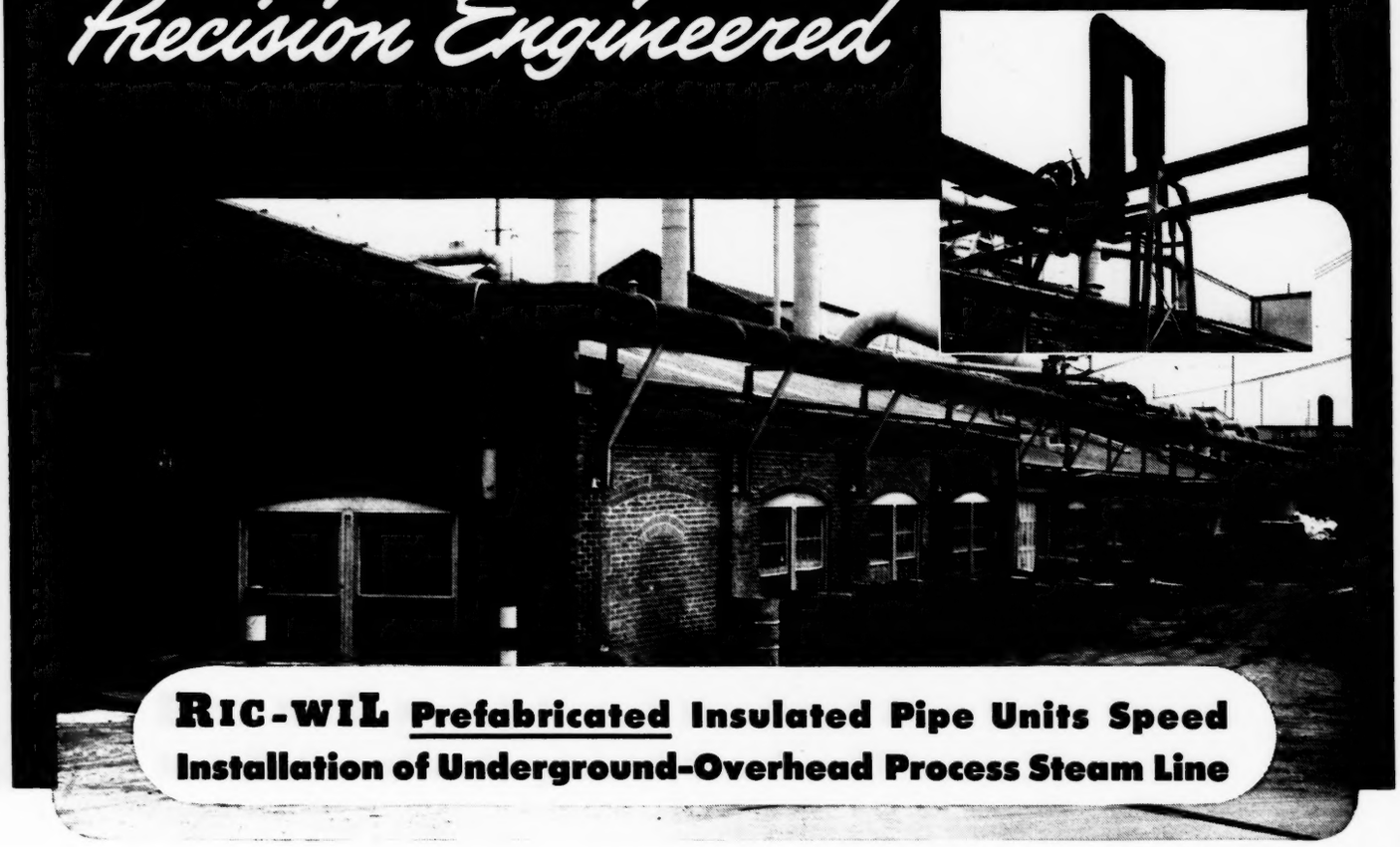
HEATING AND VENTILATING

Precision Engineered



RIC-WIL Prefabricated Insulated Pipe Units Speed Installation of Underground-Overhead Process Steam Line

A PROCESS STEAM LINE recently installed at a large adhesives manufacturing plant demonstrates many of the outstanding advantages of Ric-wiL *Prefabricated* Insulated Piping Systems.

Process steam leaving the boiler head at 145 psi is delivered to the adhesives mixers—a key operation—by a line constructed of Ric-wiL Hel-cor Pipe Units carrying an 8" steam pipe and 3" condensate return. Both pipes are insulated and housed in the same conduit, which runs underground beneath two railroad tracks and a concrete roadway as well as overhead between and alongside various plant buildings.

All units, accessories and sub-assemblies were accurately prefabricated at the Ric-wiL factory to individual specifications of this installation. With the complete system and all details laid out on the drawing board, pipes were cut to precise lengths required and each component unit was precision prefabricated. Each unit was identified for its exact position in the system, ready for single handling installation upon delivery, with a minimum of field work and time required.

The inherent flexibility of Ric-wiL Insulated Pipe Units makes it possible to provide adequate compensation for stresses and reactions caused by expansion, using a minimum of expansion devices. Only one expansion loop was required for this installation since a substantial portion of the expansion was absorbed in directional changes of the line.

Precision prefabrication, protection and insulation by Ric-wiL time-proved methods assure piping systems of high thermal efficiency, corrosion resistance, durability and strength, coupled with speedy, low-cost installation.

★ **Ric-wiL Prefabricated Insulated Piping Systems are made-to-order for distribution piping of process liquids, viscous fluids, oil, refrigerants, steam, hot or cold water. Ric-wiL engineers will be glad to consult with you on your insulated piping problems —without charge or obligation. For full information write The Ric-wiL Co., Dept. 1X.** ★

RIC-WIL

INSULATED PIPING SYSTEMS

THE RIC-WIL COMPANY • CLEVELAND, OHIO

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HEATING AND VENTILATING

A MONTHLY MAGAZINE FOR ENGINEERS AND CONTRACTORS CONCERNED WITH THE DESIGN AND APPLICATION OF AIR CONDITIONING, REFRIGERATION, PIPING, AIR SANITATION, HEATING AND VENTILATION IN BUILDINGS

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PUBLISHERS OF MACHINERY & MACHINERY'S HANDBOOK
The INDUSTRIAL PRESS

THIS MONTH'S COVER

The delicate task of assembling the elements that go into electron tubes is carried out at the Allentown, Pa., plant of the Western Electric Co., in a large air conditioned room. Employees are required to wear lint-free smocks.

YOUR PROBLEMS

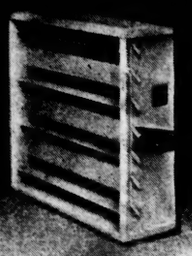
.. if those problems can be solved

UNIT HEATERS
Design No. 8

The entire lower part (the discharge outlets) revolves slowly to distribute the comfortably warmed air over entire area. Machinery, merchandise, etc., cannot obstruct constantly moving air stream as they may with single-direction air stream from fixed discharge heaters. Design illustrated is for very high ceilings as in foundries, mills, factories.

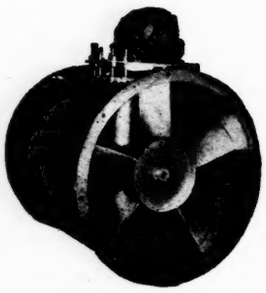
TURBINE REVOLVING UNIT HEATERS

In this newest of Wing Unit Heaters, the steam to be used for heating is first used to drive the fan, thus eliminating motors. The fan is driven by the new Wing Allsteel Steam Turbine which operates at any pressure. There is no back pressure on the turbine, no need for packing, traps or extra piping. Has revolving discharge outlet for any height of ceiling.



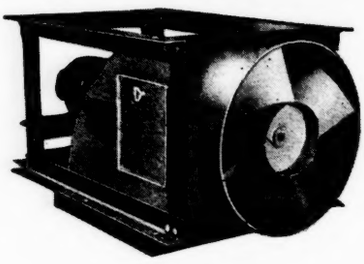
VARIABLE TEMPERATURE HEATER SECTION

Positively will not freeze because entire element is always under full steam pressure. Temperature control not obtained by steam throttling, but heating surface is divided into several narrow divisions with by-passes between. In front of each division and by-pass is a damper. Regulating positioning of dampers controls delivered air temperature.



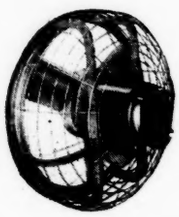
DUCT FANS
Straight Line Type

Designed to form a part of any straight run of duct. The motor is mounted on an adjustable base outside of the housing. V-belt drive is through an air tube carried across the housing and supporting fan shaft and bearings. Fan wheel is the new, non-overloading Wingfoil Fan. Bearings are grease-sealed, requiring minimum of attention.



DUCT FANS
Elbow Type

Designed to form an elbow in the duct system, the elbow-shaped housing, in a strong rectangular frame, permits installation with the inlet in any desired position. Motor and drive are outside the air stream, therefore remain cool, clean, and easily accessible. The new Wingfoil Fan has a remarkable "non-overloading" characteristic. Sizes 10″ to 60″; capacities up to 60,000 CFM.



SAFETY VENTILATING FANS

Distinguished for efficiency and rugged construction. The new Wingfoil fan wheel moves maximum volumes of air with minimum horsepower, due largely to its non-overloading feature. Sizes from 10″ to 60″ dia., with free air capacities from 860 to 58,000 CFM. Larger sizes on special order. Either direct or belt drive. Heavy steel guards provide safety.

Wing

Unit Heaters
Ventilating Fans

WING

L. J. Wing Mfg. Co.

158 W. 14th Street, New York 11, N. Y.

Washington News

LORING F. OVERMAN

IT is time again, Janus-like, to take a backward look at where we've been, in the hope of reaching some sort of a conclusion as to where we may be going.

At this time last year an Administration flushed with the power of what it interpreted as a mandate from the people, was preparing to take over Washington, lock, stock and barrel.

The Taft-Hartley law must be repealed forthwith. Taxes must be raised 4 billion dollars. The compulsory health program must be enacted, there most be federal aid to education, a complete civil rights program, more aid here, more largesse there. Wage-Hour law coverage must be broadened and the minimum wage raised. There must be a federal housing program including publicly financed slum clearance.

There were others on the list of mandated "musts," but it is significant that after the longest continuous session on record, the 81st Congress was able to enact only a fraction of its program. The Housing bill passed, the minimum wage was raised to 75c an hour, foreign aid programs were approved, and national defense was taken care of. With the exception of a few other legislative acts of relatively minor importance, the Congressional session ended with implications that the mandate had encountered a roadblock.

Whither Now?

By the time this column reaches readers, Congress will have received the President's message on the state of the nation. And the country will know whether there is continuing evidence that top Washington is still pointing toward the oft-quoted "spend and spend, elect and elect" premise.

At this writing there is little to suggest any great change from that viewpoint in top-level thinking. Nor is there any striking evidence that those who have been the grassroots beneficiaries of selected programs are yet ready to give up apparent immediate advantages in exchange for something less tangible.

There is, however, a growing concern. "Why did New Zealand and Australia vote to let individual enterprise try again to do what government appeared unable to accomplish?" "Is there anything to this talk of the U. S. becoming a welfare state?" "I hear they still want to raise taxes; that doesn't sound good to me." Congress will return to Washington with constituents' comments like those to think about.

Too, the recent increase in steel prices—soon to be reflected in reduced returns for the consumer's steel dollar—accentuate the fact that costs cannot be added to costs without showing up on the price tag. And millions of uncertain coal users are beginning to wonder if there wasn't some pretty good logic in the Taft-Hartley law, after all.

Strangely enough, the fact that two- and three-day weeks in the coal fields produce almost as much coal as last year's five-day week has proved a surprise to miners, producing companies, the public, and perhaps John L. Lewis. Some see in this paradox further evidence of what individual enterprise can do when it really gets to work. (Explanation given for the per man increase in coal production is that the miners are really exerting themselves while on the job, to draw bonus pay for individual production totals.)

Year of Decision

In any event, while a majority may not yet be ready to follow the lead of New Zealand and Australia, there is an increasingly vocal minority to whom the question, "Whither now?" has become of immediate importance. Among these, lethargy is giving way to determination, and under such conditions, minorities have been known to grow into majorities in record time.

To both the Administration and to those who oppose its thinking, the time element will be of greater importance this year than last. In 1949, convening of a new Congress involved a lot of time-consuming committee reorganization, as well as new hearings on proposed legislation. In 1950, Congress picks up where it left off at recess. Zealots will be primed to grab the ball and rush it over the line, if possible. before the opposition senses the play. It may be recalled that last year, after three months of signal-calling, the only significant bit of legislation that had been passed authorized an increase in the President's salary. This year there will be little time for procrastination.

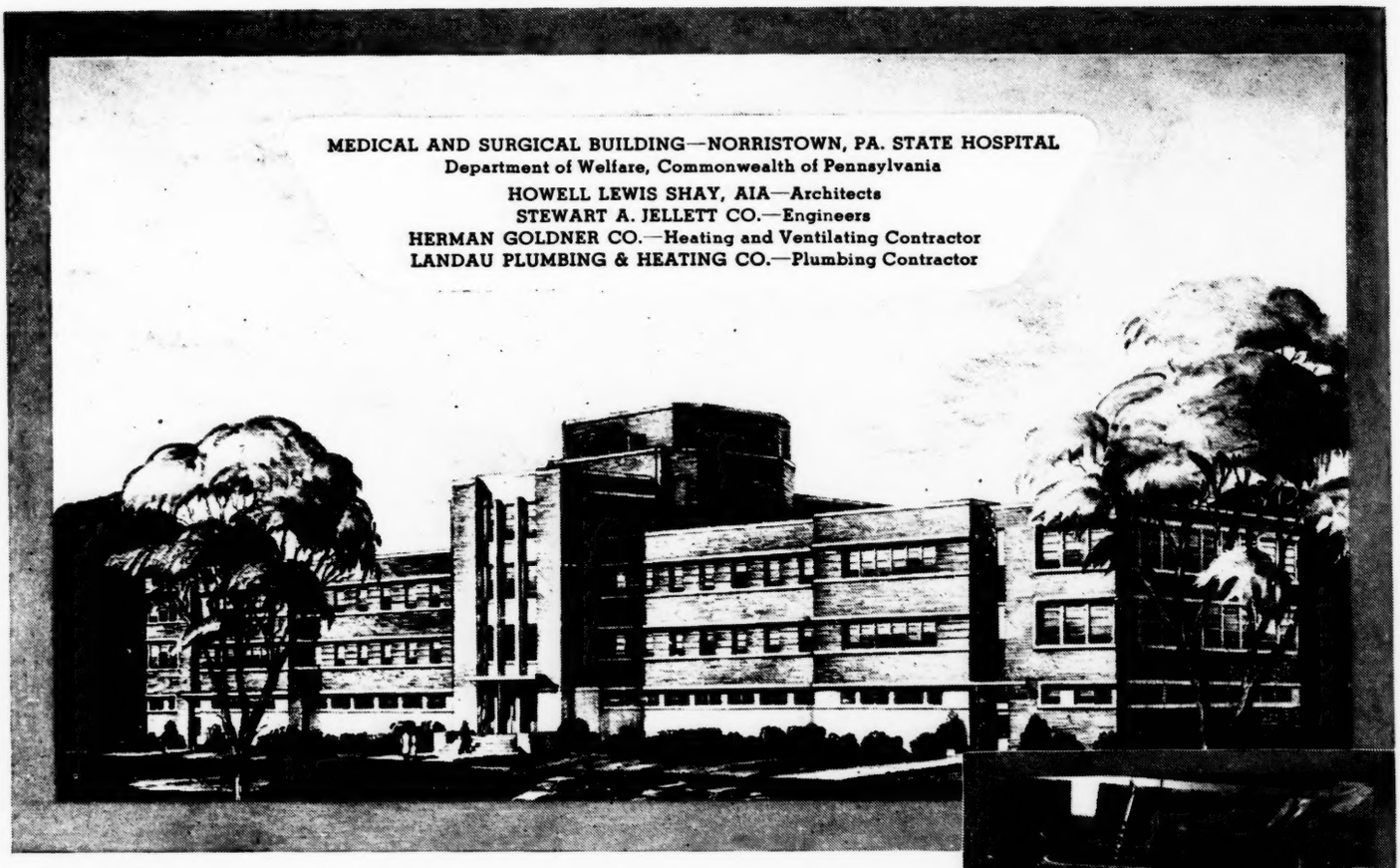
It may be assumed that Members of Congress have been contacted, during the recess, by the proponents of all the controversial measures. It is to be wondered whether the opponents took the trouble to present their views. If not, now is that time.

Two Budgets

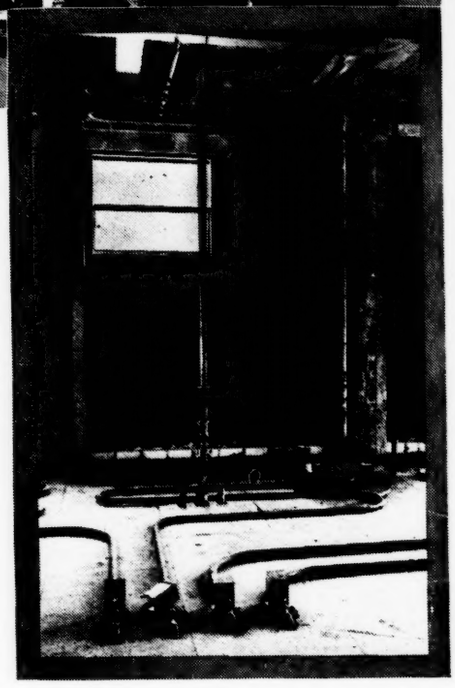
For those who are not in favor of mushrooming federal activities, perhaps the best way of calling a halt would be to investigate Virginia Senator Harry Byrd's cut-'em-off-at-the-pockets budget. It is axiomatic that federal activities will expand no further than appropriations permit.

With this in mind, Senator Byrd proposes for fiscal 1951 a federal budget of $36 billion, which is $2 billion more than in fiscal 1948, and $7.5 billion below estimated expenditures for the current fiscal year. Revenues estimated in the Byrd budget for the next fiscal year are $38 billion, leaving a $2 billion surplus to be applied to the national debt.

For domestic-civilian services, exclusive of veterans and interest payments, the Byrd budget proposes spending $8.9 billion as compared with estimated current expenditures of $11.9 billion; for veterans, $5.3 billion as compared with $6.8 billion; for foreign spending, $4.8 billion as compared with $6.8 billion; for national defense, $10.3 billion as compared with



MEDICAL AND SURGICAL BUILDING—NORRISTOWN, PA. STATE HOSPITAL
Department of Welfare, Commonwealth of Pennsylvania
HOWELL LEWIS SHAY, AIA—Architects
STEWART A. JELLETT CO.—Engineers
HERMAN GOLDNER CO.—Heating and Ventilating Contractor
LANDAU PLUMBING & HEATING CO.—Plumbing Contractor



LOOK FOR THE PIPE WITH THE RED SPIRAL STRIPE

To assure pipe health . . . RADIANT HEATING and 5 OTHER SERVICES here are BYERS WROUGHT IRON

In this new hospital, the designers not only gave careful thought to the welfare of the patients—but also to the welfare of the piping on which so many services and facilities depend. Byers Wrought Iron pipe was installed in the modern radiant heating system, which utilizes both floor and ceiling coils to warm all four floors, and in steam return lines, rain water conductors, rain water drainage above basement, refrigeration water, and refrigeration drainage lines. The small illustration shows radiant heating coils with balancing valves and also some plumbing risers in a bathroom in the nurses' quarters.

With so many new hospitals now being constructed throughout the country, it is vital to assure that these aids to community health do not bring financial headaches through excessive upkeep charges. In corrosive piping services, where premature failures would entail a continuing burden of maintenance, engineering experience recommends wrought iron for protection. The tiny fibers of glass-like silicate slag that are threaded through the high-purity iron body of the material halt and disperse corrosive attack, and so discourage pitting and penetration. The fibers also anchor the initial protective film, which shields the underlying metal.

A knowledge of the nature, characteristics and methods of manufacture of wrought iron is an excellent guide to its proper application. Our booklet, THE A B C's OF WROUGHT IRON, gives the complete story. Ask for a copy.

A. M. Byers Company, Pittsburgh, Pa. Established 1864. Boston, New York, Philadelphia, Washington, Atlanta, Chicago, St. Louis, Houston, Salt Lake City, San Francisco. Export Division: New York, N. Y.

CORROSION COSTS YOU MORE THAN WROUGHT IRON

$12.3 billion, and for interest on public debt, $5.7 billion as compared with $5.6 billion.

Unless cuts are made in the anticipated Administration budget for fiscal 1951, Senator Byrd contends, it will be necessary to levy new taxes to raise in excess of $7 billion, or to continue "gaily along the economic primrose path of indefinite deficit spending."

Who Can Pay?

Getting the additional $7 billion from corporations, he points out, would require raising business taxes 60%. If the amount is to come from individuals, their taxes must be raised 40%. Or an average increase of 25% on both corporations and individuals would produce the $7 billion. The Virginia Senator contends that such increases would either plunge the nation into a depression or hasten a sharp economic reversal.

Undoubtedly it would result in a quick political reversal.

It is this latter probability that permits Washington observers to predict that the Administration will be rather selective, votewise, in proposing new taxes. Eyed will be corporations, higher-bracket incomes, and estates and gifts. Indicative, however, of the tax-consciousness of "the people" is the heavy pressure to reduce taxes during this election year, particularly some excises.

Economy Maybe

The Byrd budget is being viewed by many in Washington as providing members of Congress with a blueprint for spending cuts which can be defended in their home districts. Another point favorable to consideration of the Byrd budget is a change in legislative procedure. It will now be possible for Congress to consider all spending bills in one measure, instead of as individual proposals, and to trim the larger Administration budget to Byrd specifications if they so desire.

Whether this will be done will depend upon how forcefully constituents insist upon such action. Further hope of cuts is seen in the proposal of Senator McClelland (D., Ark.), for the creation of a joint committee similar to the Joint Committee on Internal Revenue Taxation, to serve as a watch-dog group on appropriations and spending. The I. R. Joint Committee is staffed with experts who advise the two tax-making committees of Congress. The proposed McClelland joint committee would serve the Appropriations committees, and would submit reports on the spending operations of executive agencies.

Going Up

Just how hard it will be to get objective public support for cut-spending moves at a time when so many are riding some particular up-current can be demonstrated by taking a look at the construction picture. Government figures for November report 93,000 starts during the month—greatest number of November starts in history; 50% above the same month in 1948. And for the first 11 months of 1949, despite a slump in midyear, there were 937,100 non-farm dwelling starts. The total is slightly more than the previous full-year total of 937,000, begun in 1925.

"What's a little tax, compared with demand such as that," demand reflected all the way down the line through all who plan, supply and build! The unseasonal upsurge in construction has resulted in marked price increases too, in lumber, plywood, bricks, hardware—practically everything excepting paint, it appears.

Included in volume increases are many units in the heating field. October shipments of cast iron boilers totalled 37.0 million pounds, 9% above the 33.8 million pounds shipped in September. Shipments of cast iron radiation amounted to 6 million square feet in October, compared with 5.4 million feet in September. October shipments of oil burners totalled 97 thousand units, compared with 94.8 thousand in September. October shipments of 72.2 thousand units of floor and wall furnaces were 14% greater than September's 68.5 thousand units. Showing a decline, however, were warm air furnaces. October's 103 thousand units were off 8% from the 111.6 thousand shipped in September.

HHFA Impact Coming

Perhaps the current upsurge in building reflects the anticipated impact of the federal slum clearance and urban redevelopment program. On December 20, Raymond M. Foley, Administrator of the Housing and Home Finance Agency, announced that the agency is ready to receive official requests from cities for initial reservations of the capital grant funds. Congress has authorized $500 million in capital grants and $1 billion in loans to carry out the foregoing phase of the program in the Housing Act of 1949.

City officials, executives of local redevelopment agencies, and housing authorities in more than 500 communities are being sent instructions and explanatory material relating to the allocation of the first $200 million of capital grant authorizations. Reservations based on the first $200 million, the amount specified by law for allocation during the first two years of the program, will be received until July 1, or until the reservation limit is reached.

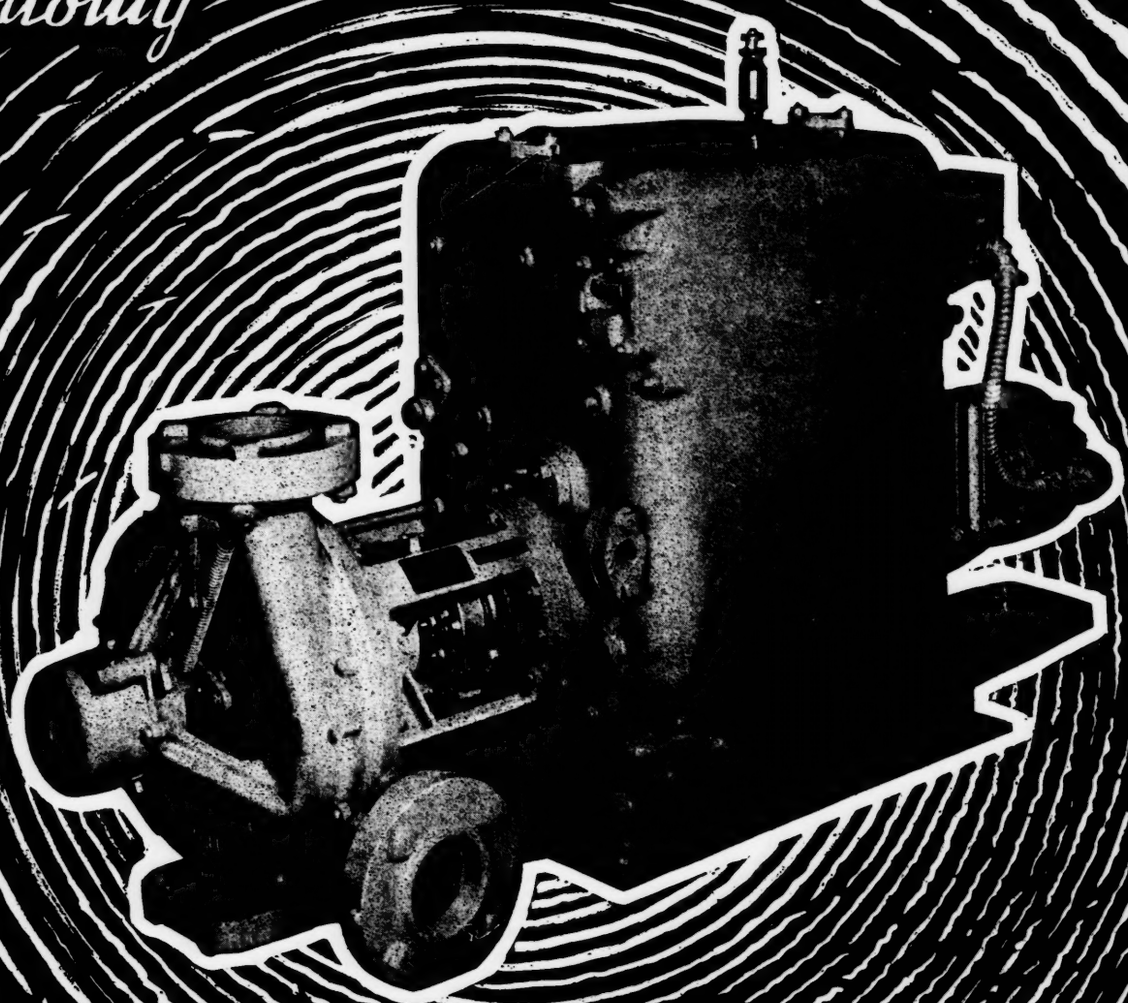
The receipt of initial reservation requests will be followed shortly by the issuance of application forms and detailed regulations governing federal assistance for specific slum clearance projects. Instructions being sent out cover only requests by which legislative and governing bodies of communities may signify their intention of proceeding with a slum clearance project.

175 Cities

The Slum Clearance and Urban Redevelopment Division of HHFA has received reports that 175 cities in 40 states intend to participate. Almost one-third of them are in the small city class of 25,000 to 40,000, according to Nathaniel Keith, Director of the Division.

The slum clearance program was approved by Congress in the Housing Act of 1949, which became law by signature of the President on July 15. Funds for administration of the program were appropriated by Congress in October and organization of the new slum clearance and urban redevelopment division immediately followed. Since then the division has been staffing the necessary offices and preparing policy regulations and procedures necessary in the carrying out of federal responsibilities toward the program.

Centralized Heating Economy



A RETURN LINE VACUUM PUMP THAT CUTS HEATING COST.

This unusual pump needs no electric current, cutting out greatest item of pump operating expense.

More important, this pump insures absolutely uniform circulation in system. That means continuous steam economy.

Simple, compact, one moving element, no wearing parts, no internal lubrication. Bulletin No. 203 gives the facts. Your copy is waiting.

THE NASH ENGINEERING COMPANY
SOUTH NORWALK, CONNECTICUT, U. S. A.

Designing for Air Purity

A. M. HANFMANN
Western Electric Company

Air cleaning in industrial plants is often used to prevent damage to the product. Since the specific requirements will vary with the industry, no generalized set of rules would be applicable for all plants. However, the process of assembling and applying design data is generally the same in all industries. An illustration from an electronics plant thus may be of some interest for any designer of air cleaning installations.

THE importance of clean air for the manufacturing processes of the electronics industry is well known. Comparatively small amounts of impurities may vitally affect the characteristics of vacuum tube parts. The coating process for cathodes and filaments is a good example. An impurity in the coating amounting to more than a few micrograms of chlorides or sulfides, per square centimeter, may result in a "poisoned" or deficient cathode. Aside from chemical considerations, any dust or oil particles may interfere with the uniform coating of cathodes and filaments.

Sources of Contamination

The sources of injurious air impurities may be either outside or within the plant. Among the external offenders are industrial plants, quarries, smoke from railroads or domestic heating, mines and steel mills, and plain dusty roads.

Contaminations originating within the electronics plant are often more dangerous and more difficult to detect. Chemical cleaning and plating processes, an essential part of the electronics manufacture, may release sulfides, chlorides and other contaminants. Sulfur is also contained in the city gas used for heating glass parts of electronic tubes. Finally, any abrasive surface, such as a concrete floor, may originate dust; the numerous piping services typical of an electronics plant form depositories for dust to be shaken loose during maintenance work. Lint from clothing may be deposited at a rate from 2 to 10 lint particles per square inch per hour in a clean plant. Deposited on the tiny wires of a closely spaced miniature tube grid, such a particle may carbonize and cause short circuiting, unless an additional operation is added to burn off or clean off such a particle.

Data for Reduction of Impurities

To provide means for reduction of the contaminants, it is advisable first to find out what impurities are present. This is particularly true when a new electronics plant is being planned.

The Western Electric Co., in planning the Allentown plant (1, 5), made an effort to evaluate the probability of air contamination and to provide both building and equipment features to reduce the danger to the product.

To get a picture of the air impurities outside the plant, methods developed by the Bell Telephone Laboratories were used. The likely sources of impurities were cement mills 5 to 7 miles to the north, Bethlehem Steel works 6 to 7 miles to the east, and smoke from the railways, plants and houses in Allentown, about 2 miles to the west. The prevailing wind was from the west. Morning fogs (90% to 100% relative humidity) are common in the Lehigh Valley up to 25 times a month (2).

Tests made were a sulfate and sulfide count, a dust

Numbers in parentheses refer to references listed at the end of this article.

TABLE 1—SULFATE COUNTS FOR OUTSIDE AIR IN NEW YORK CITY AND ALLENTOWN

Test Location	Elevation Above Ground	Dates of Exposure		Micrograms SO_3 Per Sq In. of Paper Per Week	
		From	To	Individual	Average
New York City,					
West St.	13th floor	8-28-45	9-6-45	1355	1227
97th St.	5th floor	8-28-45	9-6-45	1100	
Allentown,					
Plant site	9 to 12 ft	9-4-45	9-18-45	293	395
Plant site	9 to 12 ft	9-4-45	9-10-45	366	
Near plant	9 to 12 ft	9-4-45	9-10-45	358	
Near plant	9 to 12 ft	9-4-45	9-10-45	548	
Near plant	9 to 12 ft	9-4-45	9-18-45	409	

particle count investigating also dust composition, and a tracing of dust impinging through a nozzle on a slowly moving chart, thus showing the varying intensity of dust deposition through the duration of the test. This latter test is not quantitative, but shows interesting dependency between relative humidity and dust deposition. The sulfate and sulfide counts are quantitative. They consist in exposing to the air, paper strips impregnated with sodium carbonate (for sulfates) or silver foil strips (for sulfides) for a standard period of time. Consequent discoloration tests for sulfides give results in micrograms per square inch per week which can be compared with test results in other locations. In the dust count, the particles are counted according to the size in microns. Partial results of the tests on the prospective plant site in Allentown are briefly summarized in Table 1 and Appendix *A*. They led us to believe that both dust and sulfur concentrations were one-third of the former location.

It was also confirmed that the dust deposition is highest when fogs or mists are prevalent, and that the sulfate concentrations for various locations show a relationship similar to that of the carbonaceous dust concentration (3). Details of the dust count are shown in Appendix *A*.

Sulfate tests were also carried out in the former electronics plant location. See Table 2. The sulfate content was found to be higher inside the building than outside, which proved that at least part of it was due to manufacturing processes. Highest counts were made near areas with many gas flames and near non-partitioned plating areas. Lower counts were observed in rooms with air supplied by fans through coarse filters. For sulfate counts, 100-200 is considered very good; 200-300, good; 300-800, average; 800 and up, bad.

No gaseous sulfur dioxide is normally expected to be stopped by such a filter. There is possibility that droplets of moisture are formed around dust particles, dissolving some soluble gaseous impurities (3). The precipitation of such particles in the filter may thus, in some cases, incidentally reduce the sulfate count.

Tests described and also data available in literature were used first for fundamental plant design considerations and secondly for the choice of air conditioning and filtering equipment (5).

Since observations show that contaminants concentration is highest near the ground, most air intakes were located as high as possible. To prevent cross contamination from process exhaust, many exhaust openings were provided in the roof of the low periphery rooms circling the central high portion of the plant. Where this was not feasible, exhaust openings were provided as far as possible from the air intakes and with regard to the prevailing wind. The window panes consist of two thicknesses of glass with a 3/16 inch air space sealed in. There are no cracks for the outside air to enter. All entrances are through vestibules or staircases with double doors. The building is kept at a higher static pressure than the outside air—1/16 inch normally, 1/8 inch during windy days. To keep this pressure within limits, large relief louvers are provided in the walls. The air conditioning system of the Allentown plant (1) will be mentioned here only within the scope of this article.

The manufacturing and office buildings are served by a system of 2,310 tons refrigeration capacity, designed to keep the building at 80F and 50% R.H. in summer and 70F and 40% R.H. in winter. At partial loads the controls are set to keep the building between these extremes.

Filters of this system through which all air entering the building must pass, Appendix *A*, were intended to remove the coarser particles from the air. The efficiency of such filters (4), coupled with the compar-

TABLE 2—SULFATE COUNTS IN ELECTRONIC SHOPS—COMPARISON BETWEEN NEW YORK CITY AND NEW ALLENTOWN PLANTS

Test Location	Air Supply Data	Dates of Exposure		Micrograms SO_3 Per Sq In. of Paper Per Week	
		From	To	Individual	Average
Cathode and filament coating	NF	2-24-45	3-3-45	1459	1218
	NF	2-24-45	3-3-45	1018	
	NF	2-24-45	3-3-45	1499	
	OA, CF	2-24-45	3-3-45	887	
	AC, EP, CF	7-6-48	7-23-48*	99	
General assembly area	NF	Various dates; 1944 and 1945			1722
	AC	7-2-48	7-23-48*		264

*Counts for Allentown, Pa. Unless so marked, counts are for plant in New York City. Abbreviations used: NF—no filtering, air supplied through windows; CF—coarse filtering, air supplied by fan; AC—air conditioning system, dry filters; OA—outside air supply only; EP—electrostatic precipitator.

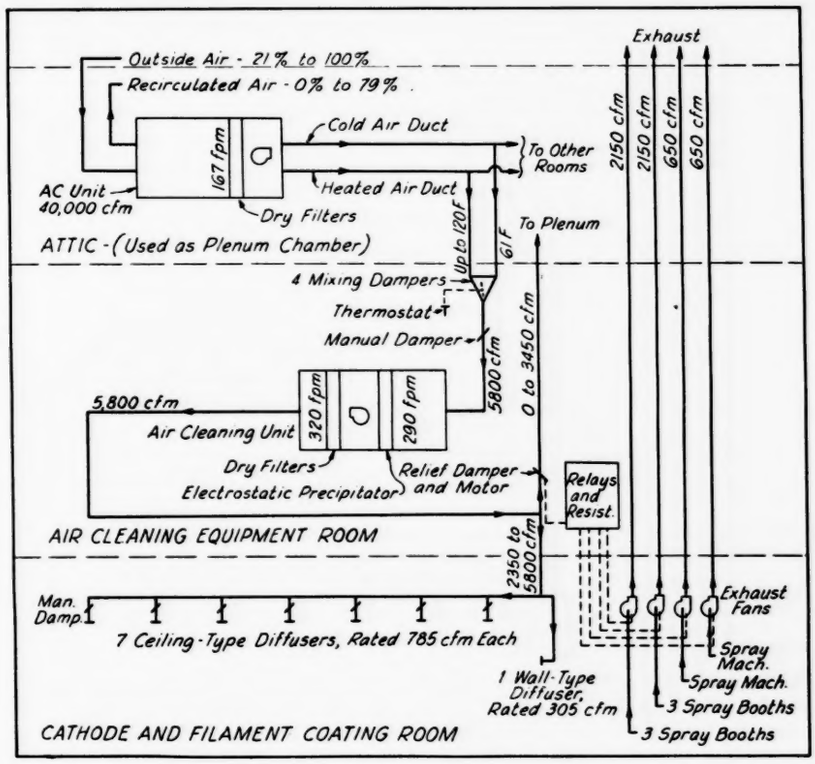


Fig. 1. Schematic diagram showing air supply and exhaust.

atively low outside air contamination in Allentown, was assumed to satisfy the normal requirements for electronics products. Any special requirements for freedom from contaminants were to be handled in separate rooms by additional equipment.

One plan to fight the contaminants originating within the plant is to remove them at the source by such means as a strong exhaust combined with enclosing either an individual piece of equipment or a whole area.

Enclosing the offending area helps. A certain air velocity is required either to overcome the vapor pressure of vaporous contaminants or to impart sufficient velocity to solid particles. Hence, the designing engineer wishing to reduce the expensive cfm, must reduce the area where the air flow occurs (6). This is difficult at the equipment itself, since the hood must be effective over the whole area of contamination and still leave access for the operator. It is easy, however, once the area is enclosed, to provide adjustable louvers in the partition. Placed so as not to affect the occupants, these louvers can be adjusted for small areas and high velocities. This design tends to confine to certain areas such contaminations as cannot economically be removed by exhaust at their source. The Allentown plant is designed to provide space in the peripheral rooms for such partitioned rooms, while the central 400 ft x 325 ft part of the main manufacturing floor is one large open area. The partitioned space is also used for rooms where special requirements for air purity or for temperature and humidity conditions force separations from other areas.

Another means to reduce the amount of exhaust air leaving the building is to recirculate it after passing through the filters. This is a standard practice with coarse dusts generated by grinders, woodworking machines, etc. Some fine dusts tend to clog the filters and an example of a design used to overcome this difficulty is described.

To reduce dusts generated on the main manufacturing floor, all piping services are carried either through the lower floor or through the attic separated from the main floor by a hung "sanacoustic" tile ceiling. Walls of the building are covered with glazed tile; the main floor in most areas is hardwood; partition material is mostly painted transite; the ceiling of the peripheral rooms is formed by painted steel decking. These materials are easier to clean and are less abrasive than many other standard materials. In certain areas, smocks and gloves of special material are worn to minimize contamination by line and perspiration.

Design Considerations

The general principle of partitioning off special rooms in the peripheral area was also applied to the cathode and filament coating room. In addition, two vestibules with two doors each were provided to reduce air exfiltration.

The peripheral space air conditioning units each supply a series of rooms. To provide for individual control in rooms with varying cooling and heating load conditions, these particular units have one cold and one warm air supply duct, with mixing dampers individually controlled by room thermostats. There are no radiators and the whole cooling and heating load is carried by the air conditioning unit. Therefore, the amount of air supplied to this room must satisfy both ventilation and thermal requirements. Spraying processes in the room require the use of four separate exhaust systems. Capacities of these systems, computed for safety requirements (9, 10) are 2,150 cfm, 2,150 cfm, 650 cfm and 650 cfm, so that the maximum exhaust requirements are 5,600 cfm. Beyond that some amount is necessary to keep the room pressurized. Since the cooling of this room required 5,800 cfm maximum, this figure was chosen for rating the equipment which includes 200 cfm for pressurizing, resulting in a pressure difference of approximately 1/16 inch water. Details of equipment ratings are given in Appendix *B* and a schematic of air flow in Fig. 1.

It is also advisable to keep a measure of air flow at all times to prevent concentration of solvent vapors. Therefore, one 2,150 cfm exhaust fan is scheduled to run constantly, thus requiring a minimum of 2,350 cfm of air supply to replace exhaust and exfiltration.

Between the minimum of 2,350 cfm and the maximum of 5,600 cfm, there are six other possible steps. The six steps and the off position employed result in a seven-step control.

Air purity requirements extended to particles of less than 0.5 microns, the range of an electrostatic precipitator. No activated carbon filters were requested, the air conditioning unit supplying between 21% and 100% of outside air, which the air tests indicated to be satisfactory. A normally dusty process is conducted in an adjoining area, which for safety reasons must be connected with the cathode filament room by a single door. The dust from this process was to be minimized.

Design Description

To satisfy these requirements the following design was adopted. See Fig. 1 and Appendix *B*.

The design of the general air conditioning system is such that the air flow through the air conditioning unit must be kept constant. At the same time the air flow through the room supplied with purified air must vary, dependent on the number of exhaust fans in operation. Thus a varying quantity of air from the air conditioning unit must be removed. Rather than discharge this expensive air to outside atmosphere it was decided to return it to the attic, which serves as a plenum chamber for the recirculated air.

The removal or by-passing of conditioned air is done after the air passes the cleaning unit. This was done to utilize the full capacity of the precipitator at all times, even when the coating room does not call for full flow. The purified air, in excess of the coating room requirements, is released in the attic and enters the recirculated air intake of the air conditioning unit so that the purification effect is not lost.

The amount of air that goes into the attic is made dependent on the operation of the exhaust fans by a simple electrical interlock. A damper in the relief duct is positioned by a motor. The motor is connected over two legs of series-connected resistances. As long as the resistance value of both legs is equal, the motor does not move. By shunting resistances in the two legs, an unbalance is created which forces the motor to assume a new position, the amount of travel dependent on the amount of resistance shorted out.

Each fan motor is connected in parallel with a relay. The relays are used to short out resistances in the open leg or the close leg of the damper control motor. By adjusting the resistances, the damper positions may be regulated closely for the air flow desired. This inexpensive, off-on action, hookup is preferred to the modulating damper type actuated by static pressure regulators. These control features are applicable for most rooms supplied by a constant air volume air conditioning system, but with air exhausted in varying quantities. Each damper step is adjustable individually by variable resistors, free from pressure conditions which may vary within a room and without "hunting."

Air distribution in an air conditioned room with spray booths warrants low velocity diffusers with considerable aspiration or good external induction. The comfort of the operators and the reproducibility of the spraying operations both depend on fairly uniform temperature and velocity conditions at the face of the spray booths. It is essential to avoid short circuiting of cooled or heated air which often occurs from high velocity, long narrow throw types of outlets toward the spray booths. Consequently, the diffusers chosen were of a type providing a good mixing rather than a long throw and equalizing deflectors were used to improve the uniformity of air discharge.

To adjust and balance the air flow initially, both main and branch ducts are provided with manual dampers. The air cleaning unit fan is driven by variable speed pulleys. Since one exhaust fan is to remain in operation continuously, a visual signal indicates any stop of this particular fan. Particles as small as 0.25 microns are removed quite efficiently by electrostatic means.

It is advisable not to overload the charged grids of the precipitator by coarse particles and therefore a filter is recommended ahead of the precipitator. Such a filter will also help to keep out sleet or rain, which otherwise may cause excessive wear of ionizing wires. Since there is always a possibility of a power failure which might release the charged particles from the grids into the room, it is a good practice to install another filter back of the precipitator.

The choice of the filters and of the air velocities through them should take into account the impurities present, the impurities that are to be filtered out, and the filter performance.

Viscous filters and electrostatic filters equipped with curtains moving through oil were not used for production reasons. Activated carbon filters are well suited for adsorption filtering of gaseous impurities and have been successfully used for cathode spray rooms together with electrostatic precipitators. Safety rules for spraying would not allow recirculation (9) and thus activated carbon filters were omitted for economy of operation.

Dry filters ahead of the precipitator in this installation are a part of the general air conditioning system. Tested at 30 fpm, their efficiency with Cottrell precipitate dust is between 83 and 95%, dependent on the dust load. The filtering medium is still fairly useful for particles of 5 to 10 microns size. Below this size some particles may be also retained, but the most reliable method is the electrostatic precipitator.

Filters following the precipitator were chosen with regard to their washability, fireproofing, and non-adsorption qualities rather than efficiency, since they normally handle clean air. The medium is annealed glass fibers, 0.001 inch in diameter, packed so that filter efficiencies of 70 to 90% may be realized with medium sized particles. The washability is useful because to clean the adhesive from the precipitator grids, hot water (approximately 170F, 8 gpm at 40 lb per sq in) is recommended and the glass filters can be conveniently washed at the same time as the precipitator. A suitable drain is provided to facilitate washing.

The designer should know enough about the contaminant composition to prevent damage to the filter. Some very efficient media of paper-like composition will be damaged by granular particles (4), in which case the design should provide for a coarse, hard medium filter of metal or glass first and follow this by a denser, softer filter. Unusually strong concentrations of chemical contaminants require adsorption filters, chemical treatment or, if water soluble, washing or scrubbing. Some felt and wool-like media will be clogged by soft, powdery substances and some sort of

an automatic cleaning feature may have to be provided.

The minimum vertical conveying velocity for particles of known size and specific gravity is given by Dalla Valle (6) as,

$$V = 13{,}300 \frac{S}{S+1} d^{0.6}$$

and the minimum horizontal conveying velocity as,

$$V = 6{,}000 \frac{S}{S+1} d^{0.4}$$

where V is the air velocity in feet per minute, S is the specific gravity of the particles and d is the diameter in inches of the particles to be conveyed. The evaluation of these equations shows that slight air currents occurring in almost any room will overcome the tendency of many of these particles to settle. Checked in another way, the settling velocity as per Stokes' Law is not great.

The results may be used to estimate the likelihood of the dust traveling far from its source and also the exfiltration velocities to be achieved by pressurizing.

While hard wool felt has long been known to be a very efficient filtering medium, unfortunately it tends to be clogged by soft powders. This disadvantage has been recently overcome by the development of a new cleaning device, Fig. 2, in which a cylindrical felt bag is employed with dust fed at the top by a fan and collected in a hopper at the bottom. The automatic cleaning device consists of a tubular blow ring with compressed air fed into it. This blow ring is actuated by a differential pressure switch connected between the outside and the inside of the filter bag. When the felt becomes clogged the pressure difference increases and the blow ring starts moving up and down around the felt cylinder until the clogging disappears. This ring flexes the bag and, in addition, a jet of air is discharged against the felt through a narrow slit in the ring. Claimed efficiencies are in the range of 97-99.5% and even higher by weight. Air velocities through the bag are in the order of 20 fpm. This filter construction was used in the shellac and resin mixing area adjacent to the cathode and filament coating room to prevent carry-over of the shellac and resin particles to the cathode and filament spraying booths.

The comminutor and mixer in the shellac and resin mixing room were connected to the filter of the type described and the air recirculated in the room, after having passed through the filter. An electrical interlock forces the operator to start the filter fan before he starts the mixer or the comminutor.

A strong indication of the results of air cleaning is the fact that the coating room in Allentown shows a sulfate count of only 30% as compared with the nearest test location in the open area at a distance of only 36 ft. Sulfate count reductions of this order have been also observed in other rooms similarly equipped (3). Comparable results might be expected elsewhere.

The sulfide counts in general production areas showed results classified as good or 1.5-4.0 micrograms per strip per week. The results in three areas with considerable gas consumption were classified as average or 4.0-15.0 micrograms per strip per week. The limited number of sulfide counts taken so far, and the step-by-step method of evaluation of this test, makes any further conclusions impractical, although it might be mentioned that one New York count ran considerably higher.

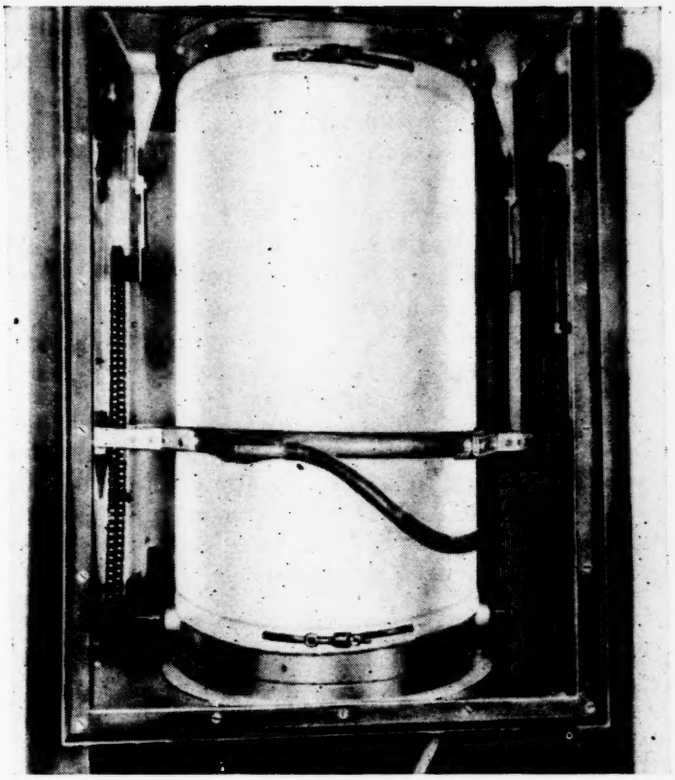


Fig. 2. Hersey filtering dust collector.

The dust count in the coating room averages roughly 35 to 40% of the dust count in the nearest open area (60% for particles of 5-10 microns, 35% for 10-20 microns, and 15% for 20-50 microns). The improvement in dust count is thus comparable to the improvement in sulfate count.

The maintenance of the air cleaning unit so far was negligible. During the first 9 months of operation, the unit was inspected several times without finding a need for cleaning. This is doubtless due to the fact that the unit handles pre-filtered air.

Conclusions

Industrial requirements for air purity are becoming more severe.

An attempt has been made to show one typical case from the electronics industry. In this case efforts were made to secure numerical data both for the expected contamination and for the equipment performance. The subsequent design was largely based on these data and on the product requirements. A reduction of contamination in a specially equipped room could be proved.

There is need for more and better data for the work of air purification. Farr, Pauley and Crismon (7) have indicated the need of improved test methods for filters. Beyond an improved test method, the design engineer would like to see filter performance data not for any standard dust (Washington, D. C. dust, Cottrell precipitate, spark plug dust) but for a series of dusts, arranged by particle size and the specific gravity.

In the electronics industry very slight impurities cause damage to parts which easily runs into thousands of dollars for any one product. The same is true of the photographic industry, optical industry, drug industry and a score of others. The field for air purification would be very wide, if the ventilation engineer could call his shots and predict the results of his suggestions. Today the lack of data limits this wide field. The purity of the air should be controlled as closely as its temperature and humidity—and it could be.

Acknowledgments

The writer is indebted to H. W. Hermance and H. V. Wadlow of the Bell Telephone Laboratories, on whose fundamental research data he has drawn liberally, and to J. J. Fry and A. E. Hendrickson of the Western Electric Co. who supplied the data referring to the cathode coating and mixing materials.

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Appendix A – Dust Composition at Allentown Plant Site and Filters Chosen

Dates of Collection—

September 4, 5, and 6, 1945.

Size of Particles—

Up to 5 microns, 89%; 5 to 10 microns, 7%; 10 to 25 microns, 3%; over 25 microns, 1%.

Observations

The amount of black carbonaceous or other colored particles of greater size, removable by mechanical filters estimated at 1/50 of that at New York at approximately the same height.

Composition of Sample

Fairly high percentage of coke particles, some coal and approximately 10% light colored mineral matter, together with cellular plant material.

Normal Application Ranges of Commercial Filters

Gases, diffused in air, (if of sufficient retentivity)—activated carbon filters.

Particles, floating or settling, up to 1 micron—electrostatic precipitators.

Particles, settling, from 1 to 5 microns—electrostatic precipitators, some special filters.

Particles, settling, from 5 to 10 microns—dry filters (felt and similar media) some viscous filters.

Particles, settling, from 10 to 100 microns—dry filters (coarser media) viscous filters and dust arresters.

Particles, large, settling or falling, over 100 microns—centrifugal cleaners, etc.

Filters used in Allentown Plant and in Cathode and Filament Coating Room

General air conditioning system: Dollinger dry type filters. Claimed efficiency 83 to 95% at 30 fpm through medium = 900 fpm face velocity, tested by the National Bureau of Standards method. Useful down to 5 microns.

Electrostatic precipitator for Coating Room: Raytheon, claimed efficiency approximately 90% at 300 fpm, tested by the National Bureau of Standards method. Useful down to 0.25 microns.

Filter following precipitator: Somers washable hair glass filter, claimed efficiency 72% at 50 fpm through medium = 207 fpm face velocity, tested by the Bureau of Standards method. Useful mainly against larger particles in the range of 10-100 microns.

Appendix B – Design Data and Equipment Schedule for a Coating Room

Air Quantities

Air flow through room required for heating	1,800 cfm
Air flow through room required for cooling	5,800 cfm
Air flow through room required for exhaust	5,600 cfm
Air flow through room required for exfiltration	200 cfm
Maximum air flow assumed	5,800 cfm
Minimum flow maintained through room at all times	2,350 cfm

Air Velocities

(Face Velocities, Not Velocities Across Filtering Medium)

Velocity over dry filters in the air conditioning unit	167 fpm
Velocity over electrostatic precipitator	290 fpm
Velocity over dry filters in the air cleaning unit	320 fpm

Filter Data

Air conditioning unit Dollinger dry type filters, medium WF-10, pressure drop—0.12 inch, approx.* at	167 fpm
Electrostatic Raytheon precipitator, cells 20 sq ft, pressure drop—0.16 inch approx.** at	290 fpm
Air cleaning unit Somers dry type filters, Pack No. 3, pressure drop—0.11 inch approx.† at	320 fpm

Fan Data For Air Cleaning Unit

Clarage, type W, Class I, size 1½, C, double width, double inlet, top horizontal discharge (used with variable speed pulleys and 2 hp motor)

Diffuser Data

7—Anemostat ceiling type diffusers type AR, No. 30, Neck 12-inch dia., 18-inch long, rated 785 cfm at 1,000 fpm neck velocity, with equalizing deflectors type ED.

1—Anemostat wall type diffuser, type W., No. 20, rated 305 cfm at 750 fpm neck velocity.

Control Data

Relief damper positioned in steps of 2,350, 3,000, 3,650, 4,500, 5,150 and 5,800 cfm by Minneapolis-Honeywell M904E motor with linkage Q605A, Damper W42 with relays and resistors.

Filter in Mixing Room

H. J. Hersey, Jr., special full automatic Hersey filtering dust collector, Bag 36-inch dia., 7-ft long, fan for 770 cfm.

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*Actual measurement, clean filters. Filters are cleaned when pressure drop approaches 0.5 inch.

**Average catalog and experience data, depends on make and layout.

†Test data at 290 fpm are 0.10-inch clean, 0.15-inch dirty.

Absorption Refrigeration Applied for Air Conditioning Offices

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A new development in the absorption cycle, using water as the refrigerant, makes possible the air conditioning of office space by a central system absorption machine. Data are presented on the operation of the cycle and machine, the steam consumption and operation characteristics.

WHILE absorption refrigeration machinery has been in commercial use as long ago as 1850, it is only recent that it has been safely applied to air conditioning. There are several air conditioning installations now in operation which use a newly developed absorption cycle that employs water as the refrigerant to produce chilled water. Of these installations, this article will only consider the 150-ton unit that serves two floors of the Consolidated Edison Company building at 4 Irving Place, New York City.

Before explaining the special refrigeration cycle of this machine it may be well to review the principles of absorption refrigeration.

The absorption cycle makes use of the strong affinity that certain substances have for the absorption of vapors. While there are many possible combinations of refrigerants and absorbents, the first practical machines and the type enjoying the most commercial acceptance in the 19th and early 20th centuries have used ammonia as the refrigerant and water as the absorbent. Fig. 1 schematically indicates a practical absorption system. A solution of water and ammonia, called "aqua ammonia" is sprayed in the absorber over a water coil which serves to keep the solution at a constant temperature. The solution at this point is weak —it has a minimum of ammonia, and a maximum of water, and draws ammonia vapor from the evaporator. The evaporator contains ammonia liquid at low pressure in which is immersed a brine coil. The evaporation of ammonia cools the brine. The water cooling coil in the absorber serves also to remove the heat of solution as the vapor condenses and is then absorbed by the weak solution.

It is desirable to keep the aqua ammonia as cool as possible so that it may absorb more vapor and become a strong solution. The strong aqua ammonia solution which collects in the bottom of the absorber is pumped to the generator through a heat exchanger. Heat is applied in the generator, causing the ammonia to be vaporized at comparatively high pressure. The weak solution that is left is returned to the absorber, while the ammonia vapor passes to the condenser. The heat exchanger serves to preheat the strong solution on its way to the generator by precooling the weak solution as it travels to the absorber.

An analyzer and rectifier are usually employed to assure pure dehydrated ammonia reaching the condenser. The condenser converts the ammonia vapor to a liquid and from this point on through the evaporator the cycle is similar to the conventional compression system. The condensed liquid passes through an ordinary expansion valve to the evaporator completing the cycle.

While no standardized procedures have been used for analyzing the performance of absorption machines, it is convenient to express its efficiency in terms of a performance ratio R, where:

$$R = \frac{\text{Useful refrigeration effect, Btu per hr}}{\text{Heat input, Btu per hr}}$$

At temperature levels generally used in air conditioning, the performance ratio of a conventional ammonia-water machine may be in the order of 40 to 45%, meaning that a heat input of about 26,000 Btu per hr is required to produce a ton of refrigeration.

The ammonia-water cycle has been used for large

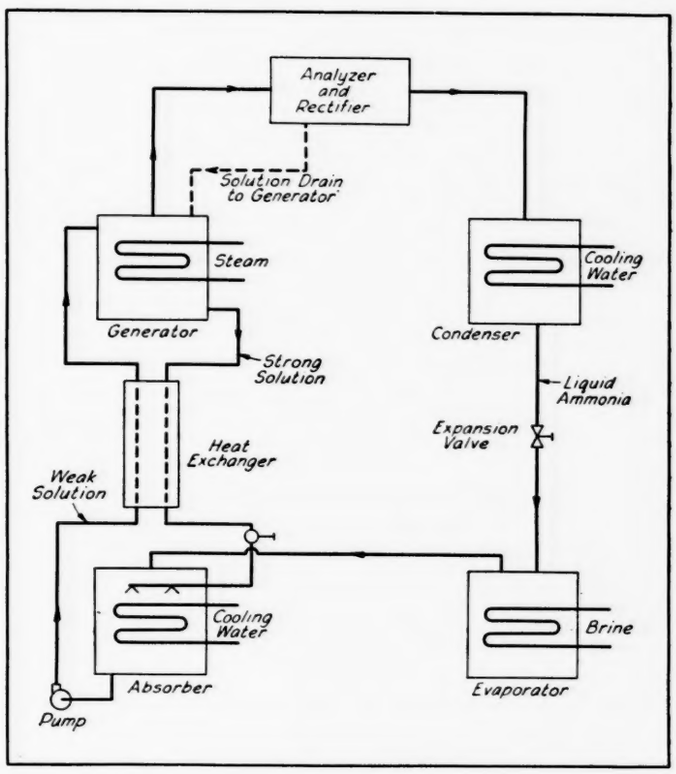


Fig. 1. Basic absorption refrigeration cycle.

Numbers in parentheses refer to references at the end of the article or refer to Fig. 3, whichever is indicated.

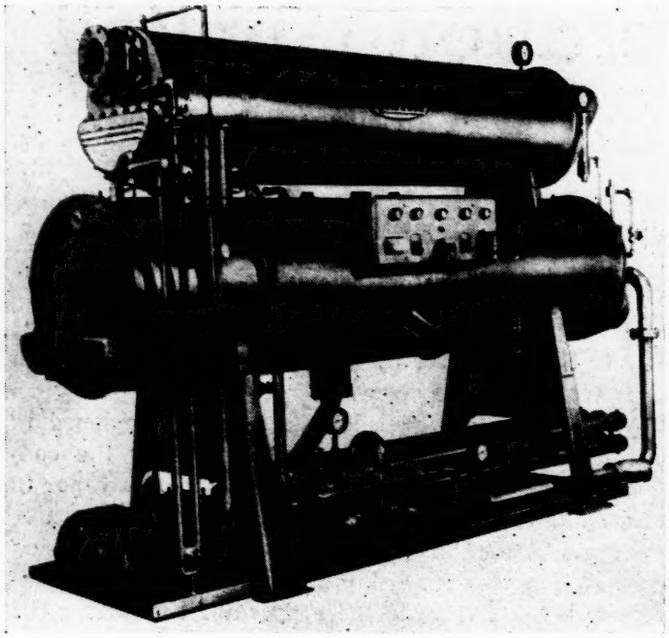


Fig. 2. Complete absorption machine ready for chilled water, condenser water, and steam connections.

commercial and industrial refrigeration systems when low cost steam was available, and in a modified form has been very successfully applied to domestic refrigeration. However, its use for air conditioning has been restricted because:

(1) It employs a hazardous refrigerant.
(2) The equipment is bulky, and, because of the complexity of vessels, it tends to become expensive.
(3) The amount of heat required per ton of refrigeration has been too high to compete with electrically driven compressor systems except where extremely low cost steam was available.

The idea, however, of using low grade, low cost energy (steam) for air conditioning is a logical one and, therefore, considerable development has been accomplished. An absorption unit specifically designed to air condition residences and small commercial establishments has been successfully pioneered by Servel, Inc. (1). This unit, manufactured in capacities of 3, 5 and 7 tons, uses water as the refrigerant and lithium bromide as the absorbent. The water is expanded directly in the air cooling coil and the solution is circulated by a percolator column. This unit achieves good efficiency. This fact plus the inherently safe solution used, overcome the objection of the ammonia-water cycle. Steam for generation can be furnished from an integrally built gas-fired boiler or from an external source.

The desire to use the absorption cycle for larger tonnages than can be met with the Servel unit, led to the development before the recent war of a machine with capacity as high as 32 tons (2). This used methylene chloride as a refrigerant and dimethyl ether of triethylene glycol as the absorbent. Steam consumption was not as good, however, as the lithium bromide-water cycle.

To meet the need for a really economical and safe heat-operated water cooling machine in the larger capacities, Carrier Corp. (3) developed a machine covering the range from 100 to 350 tons. One of these machines has been in use at the Consolidated Edison building for the past three years.

Absorption Machine

The newly developed machine is particularly adapted to the air conditioning because it uses water vapor as the refrigerant, and thus makes it possible to provide direct flash cooling of the water, thereby avoiding heat exchange surface between refrigerant and the medium to be cooled. The absorbent is a non-toxic, non-flammable, and non-explosive solution of lithium bromide. Fig. 2 shows the complete refrigeration machine ready for chilled water, condenser water, and steam connections. Fig. 3 is a schematic diagram of the flow cycle. Operation is as follows: Water to be chilled enters the unit through header (1) and is sprayed into the flash

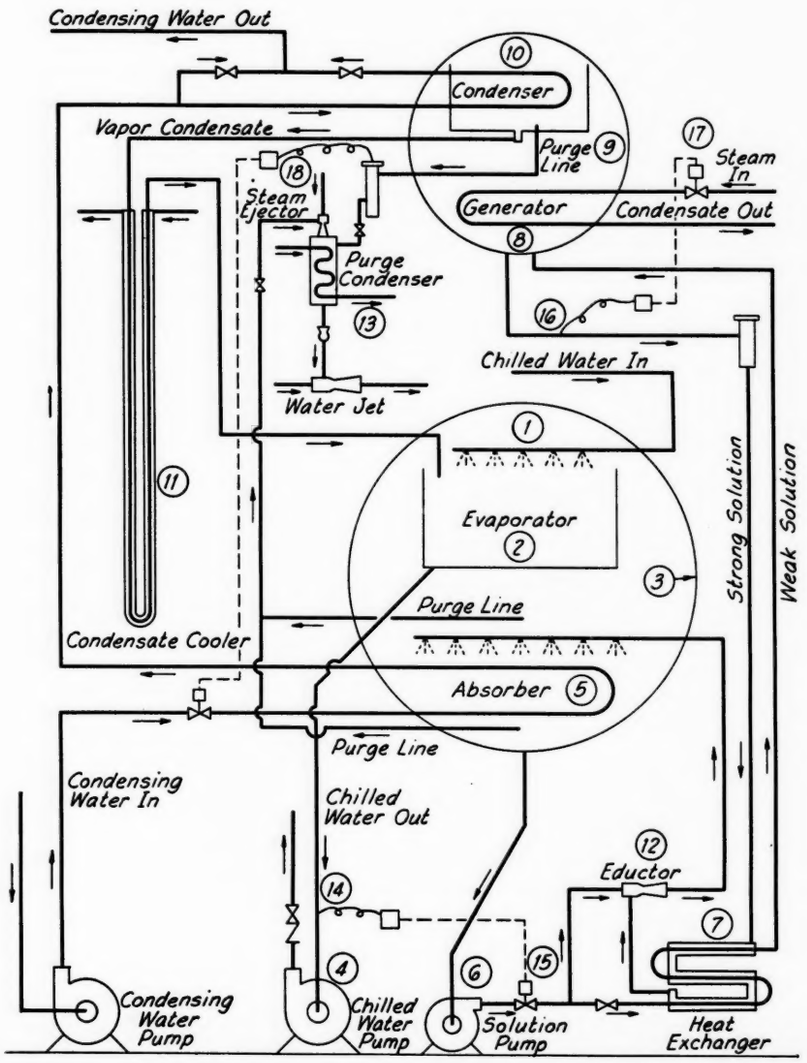


Fig. 3. Flow diagram of a high temperature absorption machine.

evaporator (2) located in the upper portion of low side shell (3). Since this shell is maintained at a low absolute pressure, a portion of the chilled water flashes into vapor and cools the remainder to a temperature nearly corresponding to this pressure. The chilled water drains from the flash tank (2) and is delivered by the chilled water pump (4) back again to the load. The pressure in the shell, and consequently the temperature of the chilled water leaving the machine is a function of the concentration and temperature of the salt solution sprayed over coil (5) located in the lower portion of the shell, which forms the absorber. The water vapor flashed in the evaporator chamber, therefore, moves down and is aborbed by this solution. Since the resulting heats of condensation and dilution tend to raise the temperature of the solution and reduce its absorptive power, the solution is continuously cooled by water passing through the absorber coil (5).

After being diluted by water vapor, the weak solution is continuously drained from the absorber shell into the 7½ hp solution pump (6). This pump delivers a portion of the solution through the heat exchanger (7) to the generator (8) which form the lower section of the high side shell (9). Steam, admitted to the tubes, heats the solution and boils off the water vapor previously condensed in the absorber, thus restoring the original concentration.

Water vapor boiled out of the solution is liquefied in condenser (10) by cooling water passing inside the condenser tubes. The cooling water passes in series through the absorber and condenser, eliminating the need for a separate supply. Condensate is returned to evaporator (2) through loop (11), which acts as a vapor seal against the difference in pressure between evaporator and condenser.

The reconcentrated solution in the generator passes through the heat exchanger (7), is cooled by counterflow with the diluted solution leaving the absorber, and enters the suction of liquid eductor (12). Here it is entrained by the other stream of solution leaving pump (6) and is delivered back to the absorber to complete the cycle. The split stream arrangement reduces the amount of heat to be exchanged between the weak and strong solutions and makes this exchange more efficient, thus securing a better performance without making the heat exchanger unreasonably large.

With water vapor as the refrigerant, both shells are maintained at a high vacuum. To remove air and noncondensibles, a two-stage purge (13) is provided, consisting of tandem steam and water eductors with an interstage purge condenser. Two purge lines are provided, one from the absorber and one from the condenser. The steam jet uses 10 lb of steam per hour while the water jet requires 30 gpm. This jet water is pumped up to the cooling tower as make-up water.

Capacity control is accomplished by a thermostat in the leaving chilled water line which throttles the solution valve (15), thereby reducing the quantity of solution reconcentrated in the generator. This reduces the absorptive power of the solution sprayed in the absorber, thus preventing reduction in evaporator pressure and consequently preventing a drop in chilled water temperature. The second temperature control element (16) is located in the hot solution leaving the

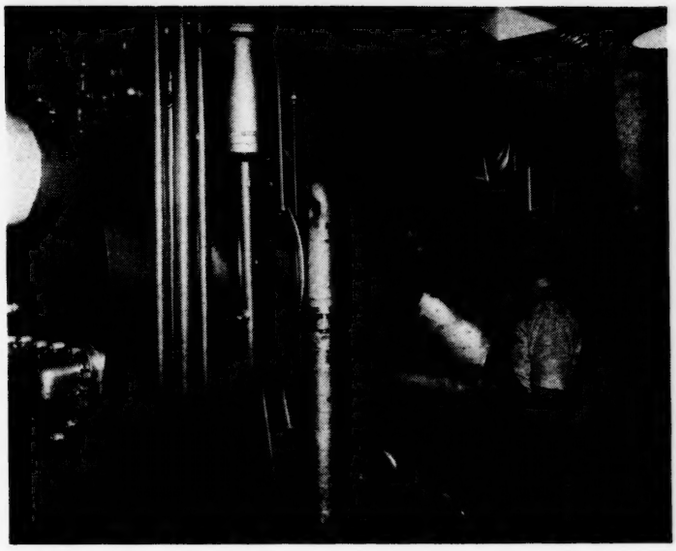


Fig. 4. Installation of absorption machine in the Consolidated Edison Co. building in New York City.

generator. Upon reduction in load, and consequently in solution flow rate to and from the generator, the solution temperature tends to rise, and the thermostat, therefore, throttles steam valve (17) to reduce the steam admitted to the generator tubes in exact accordance with the new load.

While the machine must be started and stopped manually by the opening and closing of appropriate valves, once in operation, the machine is completely automatic.

Several safety controls are provided to protect the machine from over-concentration and possible solidification of the solution in the event of accidental pump shutdown, excessive air leakage, purge failure, etc. The controls automatically shut down the machine by closing off the steam supply. One feature of the machine is the fact that accidental disruption of the cycle or failure of a safety device will not result in any serious mechanical damage, since there is practically nothing that can be broken. Because the machine operates under a vacuum at all times, it is inherently safe. The most likely cause of shutdown, that of solidification of the solution due to control failure, can be corrected in a few hours without tools or special equipment. In three years of operation of the machine at the Consolidated Edison Co., there have been no accidental cases of solution crystallization.

Performance

The machine was selected to cool 360 gpm from 55 to 45F at peak load, and there have been several days when this expected load has been imposed, and carried, by the machine. There is a characteristic variation of capacity with chilled water temperature similar to compression refrigeration machinery as indicated in Fig. 5.

At a particular condenser water temperature, there is a variation of 2.5 to 3% in capacity per degree of chilled water temperature. For example, at 85F condenser water temperature (3.5 gpm/ton) and 45F leaving chilled water temperature, the 100% capacity of the machine is 150 tons. Should the machine be operated with a chilled water temperature of 40F, the capacity would be 85% or 128 tons.

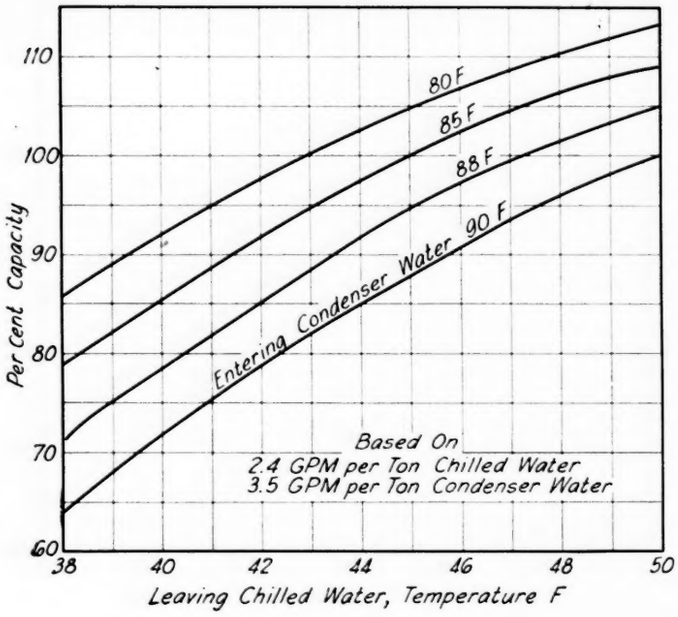


Fig. 5. Capacity of absorption machine at varying chilled water and condenser water temperatures.

The machine operates on steam at 60 lb pressure, since this was readily available from the building steam lines which in turn are served by the New York Steam Company's district steam system. The steam consumption is shown in Fig. 6. This graph was drawn as a result of actual tests run on the machine at the Consolidated Edison Co. Based on constant chilled water temperature of 45F and condenser water temperature of 85F at full load (150 tons), the steam consumption is 18.6 lb per hr per ton, and at 100 tons capacity, the rate is reduced to 17.5 lb per hr per ton. Allowing an ample safety factor, it can be stated that the machine has an average steam consumption of 19 lb per hr per ton at all loads. The efficiency, as expressed by the performance ratio, is

$$R = \frac{\text{Useful refrigeration effect, Btu per hr}}{\text{Heat input, Btu per hr}}$$

For one ton and using the latent heat for steam at 12 lb pressure

$$R = \frac{12{,}000}{19 \times 950} = 0.67$$

The fact that this performance ratio remains constant, or actually improves, at partial loads gives this machine an advantage over steam engine or turbine driven compressor machines.

The machine can be designed to operate at any steam pressure, since it only uses the latent heat on the steam which is nearly constant over a wide range of pressures. This makes possible the use of waste steam from industrial processes or steam from low pressure heating boilers which might otherwise be idle during the summer. Commercially available units are made in two standard models, one of which reaches peak capacity at 60 lb; the other at 12 lb steam pressure. The steam consumption per ton is virtually the same at either pressure. When operated at steam pressures below that used as the basis of design, there is naturally some sacrifice in capacity. This is indicated in Fig. 7 which shows the variation in capacity with steam pressure for a typical machine designed for peak operation at 12 lb steam. For example, a machine operated at 8 lb steam pressure would have 95% of the capacity it has at 12 lb steam pressure.

It is interesting to note that the performance ratio is almost double that of conventional ammonia-water absorption machines. The steam consumption is also far less than that required by steam jet machines when operating at the low steam pressures utilized by the Carrier absorption machine. The steam used also compares favorably with high pressure condensing turbine driven compression refrigerating machines, and is much less than that used by low pressure turbines.

Fig. 8 shows some typical comparisons between steam consumption of various types of steam-utilizing machines. The chart is based on a 150-ton plant with 45F chilled water temperature and 85F condenser water temperature. Constant rate of chilled water flow and condenser water flow is assumed at all loads. Moreover, it is assumed that the condenser water temperature remains constant at 85F.

Steam Consumption Comparisons

In Fig. 8, curve *A* is for an absorption machine at any steam pressure above 12 lb and for condenser water of 3.5 gpm per ton. Curve *B* is for a turbine driven centrifugal compressor operating with 125 lb steam, 26 inches vacuum, and 3.5 gpm per ton condenser water. At *D* is shown the steam consumption for a steam jet machine operating with 125 lb steam, condenser water 5.5 gpm per ton, and provided with multi-booster control. At *E* is the curve for a steam jet machine operating with 15 lb steam, 7.0 gpm per ton condenser water, and also provided with multi-booster control.

As indicated on the chart, the steam used by the absorption machine was about 18.5 lb per hr per ton

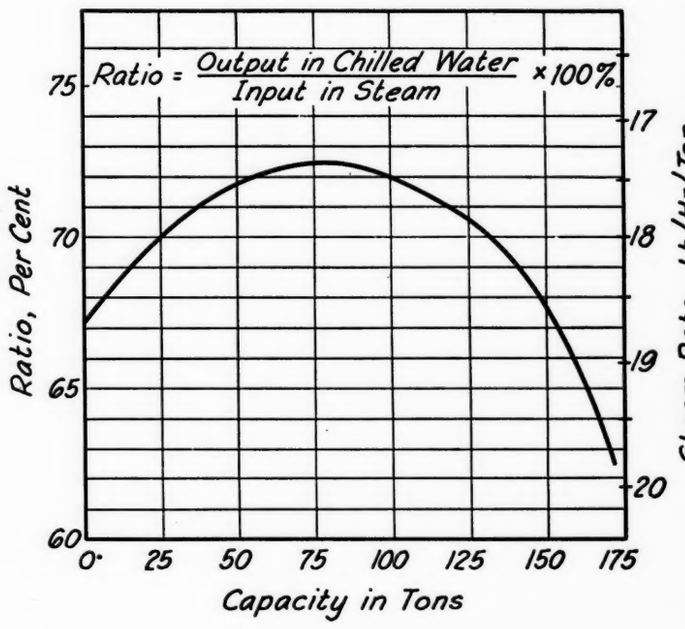


Fig. 6. Steam rate vs. capacity of the absorption unit installed in the Consolidated Edison Co. building.

at all loads. A turbine driven centrifugal machine supplied with 125 lb steam pressure has a slightly better steam rate at full load, but at partial loads, because of a drop in turbine efficiency, the steam consumption increases to about 21 lb per ton at 50% load.

Curve *C* on Fig. 8 shows that a steam turbine centrifugal machine supplied with steam at 15 lb pressure has a steam rate varying from 25 to 30 lb per hr per ton, and because more steam must be condensed in the steam condenser, the rate of condenser water flow must be increased to 4 gpm per ton. Curves *D* and *E* show the steam consumption for steam jet machines under comparable conditions. Control for partial loads on steam jet machines is usually obtained by cutting individual jets on and off, thus the curve takes a zig-zag shape, depending on the number of jets used. As indicated, a steam jet machine supplied with 125 lb steam pressure will average about 33 lb steam per hr per ton provided condenser water flow is approximately 5.5 gpm per ton. At 15 lb steam pressure, the steam consumption approximates 43 lb per hr per ton.

In an absorption machine, the heat rejected to the condenser water and hence to the cooling tower not only consists of the useful refrigerating effect (12,000 Btu per hr), but also the latent heat of the steam condensed in the generator (18,000 Btu per hr) making a total of approximately 30,000 Btu per hr per ton which is virtually double the heat rejection of an electric motor compression machine, and about the same as a high pressure condensing turbine driven machine. However, the design of the machine permits a greater rise in condenser water temperature than is customary with compression machines.

The cooling tower located on the roof at Consolidated Edison is a forced draft filled tower selected to cool 600 gpm from 100 to 85F with an outside temperature of 75F W.B. Physically, this tower is about 25% larger than that required for conventional reciprocating machinery, not 100% greater as would be supposed from the relative heat rejection. This is because the capacity of cooling towers is enlarged by added cooling range.

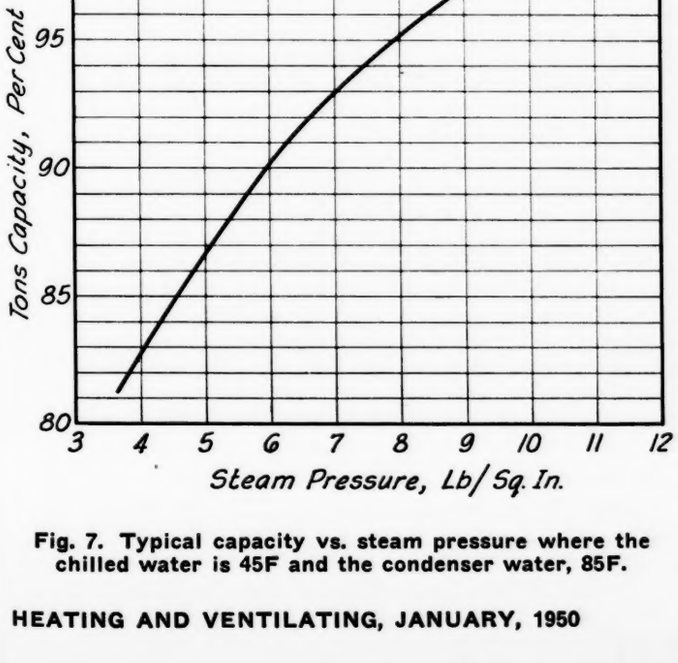


Fig. 7. Typical capacity vs. steam pressure where the chilled water is 45F and the condenser water, 85F.

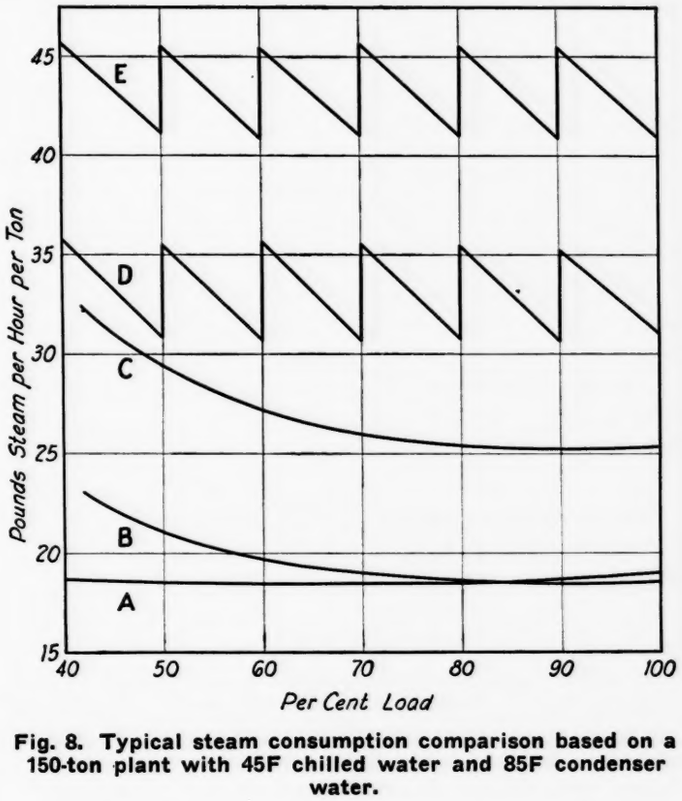


Fig. 8. Typical steam consumption comparison based on a 150-ton plant with 45F chilled water and 85F condenser water.

The variation of capacity with condensing water temperature is shown in Fig. 5. Temperatures higher than that for which the machine has been selected will result in capacity reduction similarly to that of compression machinery, but at no temperature is there a sharp break in performance as prevalent with the steam jet machine.

Since the machine operates under a vacuum, the chilled water pump must have some submersion to operate satisfactorily. This is provided inherently in the machine design since the evaporator tank is about 3 ft above the pump inlet when the pump base is at the same level as the machine base. The chilled water piping to a considerable extent is also under vacuum and, therefore, all piping is welded steel construction to prevent the inward leakage of air. This was no particular hardship, since the size of the job is such that welded construction would be used anyway. All valves are of the packless type to insure tightness. While all connections around the machine had to be carefully made and tested, no particular difficulty has been experienced in maintaining the machinery and piping free of leaks. The tightness requirement is not as severe as with other types of refrigerating machines operating at subatmospheric pressures. The purge is run continuously, since the refrigerant is water vapor and any small loss of refrigerant is inconsequential.

The chilled water produced by the machine at the Consolidated Edison building is utilized in conventional air conditioning apparatus employing extended surface coils. The machine is located on the 14th floor, with two fan rooms on the 12th floor, and one on the 15th floor. The cooling tower is on the 19th floor roof.

The open flash cooler serves also as the expansion tank for the chilled water system. However, precautions had to be observed at shutdown to prevent flooding of the evaporator by the chilled water located above

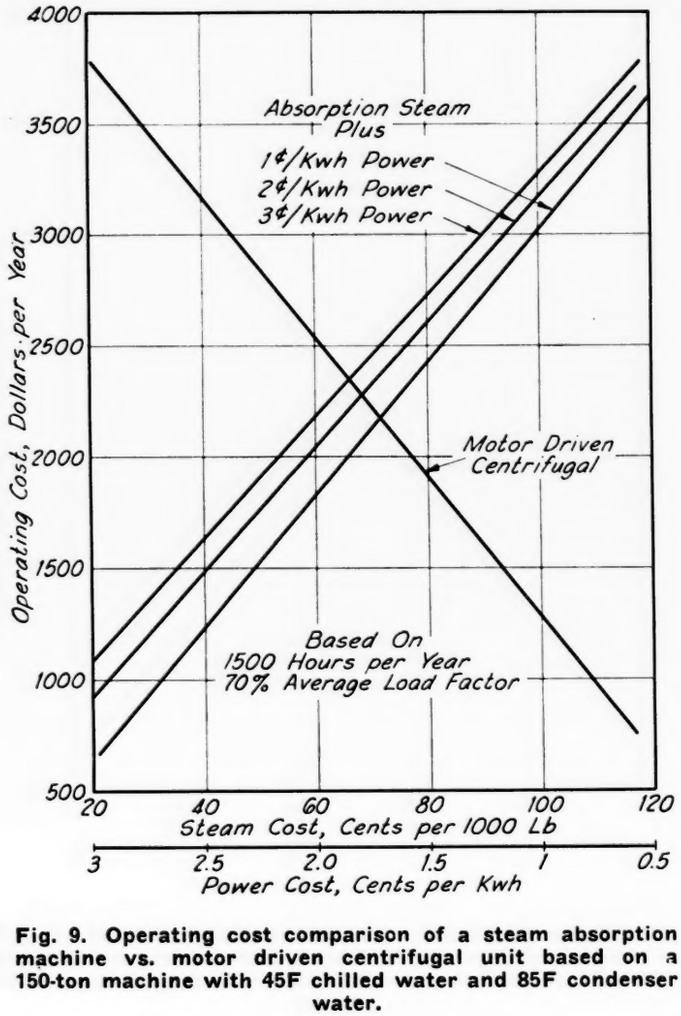


Fig. 9. Operating cost comparison of a steam absorption machine vs. motor driven centrifugal unit based on a 150-ton machine with 45F chilled water and 85F condenser water.

the machine serving the 15th floor air conditioning coils. This was accomplished by loops at the coils. The quantity of water in the risers is such that in case of accidental flooding, the storage capacity of the flash tank will not be exceeded. No particular precautions have to be observed when the machine is above, or on the same level as the load which it serves.

Since comparative steam and power rates vary considerably throughout the United States, and even within the territory of a single utility company under varying conditions, a detailed study of expected operating costs should be made for each installation. Fig. 9 is a chart showing comparative operating costs of a motor driven Freon compression plant and a steam absorption plant for a typical operating season. This chart takes into account the extra power required for the somewhat larger tower on the absorption machine. Auxiliaries common to both systems are not included. These are energy costs only, excluding labor, maintenance, supplies, etc. For example, with power costs estimated at 2c per kwh, a motor driven centrifugal machine is estimated to have an electrical operating cost of $2,550 per year based on 1,500 hours per season with 70% average load factor. This same yearly operating cost could be obtained by an absorption machine supplied with steam at 72c per 1,000 lb and power for auxiliaries at 3c per kwh.

Advantages of Installation

Let us examine the advantages of this machine, particularly as regards the Consolidated Edison building installation.

The machine is compact, light in weight, and free from vibration making practical its location on the upper floors of a tall building. The total operation weight is 13,300 lb. There are no moving parts except the 7½ hp centrifugal solution pump. A motor driven centrifugal machine of comparable capacity with customary concrete base would weigh 30,000 lb. If reciprocating machines were used, it is likely that three 60 hp compressors plus a condenser, and a Freon water cooler would have been selected. This machinery, plus its foundations, would weigh approximately 25,000 lb. The overall size of a centrifugal machine for this job would be roughly 6 ft x 15½ ft x 6 ft 4 in. high. The reciprocating combination is approximately 12 ft x 16 ft x 7 ft high, whereas the absorption machine is only 4 ft 10 in. x 11½ ft x 8 ft 2 in. These approximate machinery sizes are for refrigeration apparatus only without allowance for clearances, which would be greater for reciprocating machinery than for the other two types of machines considered.

Freedom from vibration, plus compactness and low weight, meant only minor and inexpensive structural reinforcement was necessary, and foundation costs were avoided. There are installations where similar absorption machines were installed on upper floors of existing buildings with no structural reinforcement whatsoever.

The machine is reasonably close to the cooling tower on the roof, thus conserving on the cost of condenser water piping.

As water vapor is the refrigerant and a simple harmless salt is the absorbent, there are no potentially hazardous gases of any kind. Loss of refrigerant is no problem and any leak which might lose the salt solution is visible and easily detected. In nearly three years of operation, there has been no loss of solution on this particular machine.

A suitable steam connection was readily available (as is the case in most buildings), whereas the cost of electrical service connections for a comparable motor driven plant would have been large. The steam condensate feeds into the domestic hot water preheater as is customary with all district steam installations.

The machine is very flexible with respect to meeting variations in load easily and economically. Close regulation is obtained of chilled water temperature over a load variation of from 10 to 100%.

Since there is a minimum of moving parts, maintenance and repair costs are low.

Initial cost of the absorption machine compared favorably with the cost of comparable motor driven compression plants.

References

(1) Pierce, H. C., The Servel All-Year Gas Air Conditioning Unit, *Mechanical Engineering*, Vol. 67, March, 1945, pp. 171-8.

(2) Zellhoefer, G. F., Commercial Refrigeration by Low Pressure Steam, *Refrigerating Engineering*, Vol. 33, May, 1937, pp. 317-322.

(3) Berestneff, A. A., A New Development in Absorption Refrigeration, *Refrigerating Engineering*, Vol. 57, June 1949, pp. 553-557.

Preview of Events at Dallas

Southwest Air Conditioning Exposition, State Fair Grounds, January 23-27

56th Annual Meeting, American Society of Heating and Ventilating Engineers, Adolphus and Baker Hotels, January 23-26

Two events of interest to heating, ventilating, air conditioning and refrigeration engineers have been arranged for Dallas, Tex. The Southwest Air Conditioning Exposition will be held at the State Fair Grounds, January 23-27. The 56th annual meeting of the American Society of Heating and Ventilating Engineers is scheduled for January 23-26 at the Adolphus and Baker Hotels. Following are the list of exhibitors at the exposition, the events planned for the convention, and abstracts of some of the papers.

Exhibitors at the Southwest Air Conditioning Exposition

State Fair Grounds, Dallas, Tex.

Exhibitor	Space No.
A-J Mfg. Co.	325-327
Acme Industries, Inc.	103
Aetna Industrial Corp., Trimont Mfg. Co., Div.	818
Affiliated Gas Equipment Inc., Bryant Heater Div.	459-461-463-465
Affiliated Gas Equipment Inc., Day & Night Div.	360
Affiliated Gas Equipment Inc., Payne Furnace Div.	343
Air Devices, Inc.	220
Air-Maze Corp.	105
Airtemp Division—Chrysler Corp.	203
Aldrich Co.	329-331
Allan Engineering Co.	267-269
Allis-Chalmers Mfg. Co.	820
Allis Co., The Louis	733
Alton Mfg. Co.	313
Aluminum Company of America	724
American Air Filter Co., Inc.	416-420
American Coolair Corp.	706
American Gas Assoc., Inc.	274-374-474
American Radiator & Standard Sanitary Corp.	333-337
American Sheet Metal Co.	804
Ames Iron Works	369
Anemostat Corp. of America	401
Armstrong Cork Co., Building Materials Div.	424
Armstrong Machine Works	428
Armstrong Products Corp.	251-253
Armstrong Steam Trap Co.	428
Automatic Firing Corp.	800
Automatic Products Co.	624
Baker Refrigeration Corp.	728
Baltimore Aircoil Co.	729
Barber-Colman Co.	207
Bar-Brook Mfg. Co.	631
Bauer & Black, Div. of The Kendall Co.	116-118
Bell & Gossett Co.	303
Black & Decker Mfg. Co., The	259-261
Bronson Mfg. Co.	123
Bundy Tubing Co.	619
Carrier Corp.	703-707-711
Century Electric Co.	460-462
Char-Gale Mfg. Co.	822-824
Chemical Engineering Co.	826
Chrysler Corp.	203
Climax Machinery Co.	213
Clow & Sons, James B.,	815
Coleman Co., Inc., The	370
Combustion Control Corp.	255-257
Comfort Products Corp.	212
Commercial Filters Corp.	218
Congress Drives, Div. Tann Corp.	832
Connor Eng. Corp., W. B.	117-119-121
Continental Air Filters, Inc.	211
Crane Co.	204
Curtis Refrig. Machine Div., Curtis Mfg. Co.	307
Cyclotherm Corp.	359
Detroit Lubricator Co.	614
Devices, Inc.	115-117
Dewey-Shepard Boiler Co.	454
Dodge Corp., F. W.	825
Dole Refrigerating Co.	737

Exhibitor	Space No.
Dole Valve Co., The	324
Dollinger Corp.	226-228
Domestic Engineering	129-131
Doyle Vacuum Cleaner Co.	271
Duo-Therm Div., Motor Wheel Corp.	339
Durant Insulated Pipe Co.	806-808
Dwyer Mfg. Co., F. W.	316
Fairbanks, Morse & Co.	104
Farr Company	111
Fasco Industries, Inc.	326-328
Fedders-Quigan Corp.	719
Forney Engrg. Co.	632
Frick Co.	355
Frigidaire Div., General Motors Corp.	131-133
Gannon Co., Russell R.	423
General Controls Co.	264-266
General Elec. Co., Air Conditioning Dept.	636-640
General Filters, Inc.	426
Glasfloss Corp.	830
Gold Top Heating, Inc.	732
Goodfellow Co., Inc., E. D.	421
Governair Corp.	408
Greenlee Tool Co.	231
Gustin-Bacon Mfg. Co.	252
Heating, Piping and Air Conditioning	315
HEATING AND VENTILATING	217
Holly Mfg. Co.	221-223
Hunter Fan & Ventilating Co., Inc.	811
Illinois Testing Laboratories, Inc.	232
Imperial Brass Mfg. Co., The	812-814
Industrial Press, The	217
Ingersoll-Rand Co.	715
International Mfg. Co., Air Conditioning Div.	603
International Metal Products Co.	613-615-617
International Sales Co.	330
Iron Fireman Corp.	319-321-323
Jefferson Elec. Co.	222
Jenkins Bros.	108
Johnson Service Co.	601
Joy Mfg. Co.	113
Kennard Corp.	841
Kewanee Boiler Corp.	407
Kritzer Radiant Coils, Inc.	107
Lewin-Mathes Co.	417-419
Libbey-Owens-Ford Glass Co.	434
Lilie-Hoffmann Cooling Towers, Inc.	834
Little Giant Vaporizer Co., Inc.	125
Lockformer Co., The	317
Lone Star Gas Co.	472
McDonnell & Miller, Inc.	230
Marley Co., The	410
Marlo Coil Co.	605-607
Mid-Continent Metal Products Co.	468-470
Midwest Air Control	643
Milwaukee Gas Specialty Co.	456-458
Minneapolis-Honeywell Regulator Co.	744-745
Mitchell Mfg. Co.	629
Morse-Smith-Morse, Inc.	128
Mueller Furnace Co., L. J.	304-308
Multi-Vent Div.	432
Mundet Cork Corp.	245-247-249
Nelson Corp., The Herman	440
Nesbitt, Inc., John J.	633
Niagara Blower Co.	741
Norman Products Co.	404-406
Ohio Foundry & Mfg. Co., The	464-466
Oran Co.	248
Outside Venetian Blind Co.	710-714-718
Owens-Corning Fiberglas Corp.	112-114
Pacific Steel Boiler Div., U. S. Radiator Corp.	130-132
Palmer Mfg. Corp.	702
Patterson-Kelley Co., Inc., The	838-840
Pennsylvania Furnace & Iron Co.	356
Pittsburgh Corning Corp.	127
Plumbing and Heating Journal	430
Polaire Cooler Co.	610
Powers Regulator Co.	833-837
Prat-Daniel Corp., Thermobloc Div.	224
Quiet-Heet Mfg. Corp.	816
R C S Tool Sales Corp.	829
Radiant Utilities Corp.	427
Ralph Supply, Inc.	611
Randall Graphite Bearings, Inc.	219
Ray Oil Burner Co.	382
Ready-Power Co., The	363
Redmond Co., Inc.	124-126
Refrig. Appliances, Inc.	628
Refrig. Engineering, Inc.	635-637-639-641
Research Products Corp.	438
Reynolds Metals Co.	214-216
Ric-wiL Co., The	403
Ridge Tool Co., The	448-450-452
Robertson Co., H. H.	120-122
Royal Heaters, Inc.	836
Remington Air Conditioning Div., Remington Corp.	265
Sarco Co.	215
Servel, Inc.	469
Sheet Metal Worker	430
Siemon & Co.	241
Skidmore Corp.	351
Smith Corp., A. O.	254-256-258-260-262
Southland Supply Co., Inc.	364
Stewart Warner Corp.	270
Sunstrand Machine Tool Co.	415
Surface Combustion Corp.	348-352-447-451-453
Tal Bender, Inc.	828
Tennessee Enameling Mfg. Co.	243
Texas Lawn Sprinkler Co., Inc.	810
Titus Mfg. Corp.	318
Torrington Mfg. Co., The	208
Trion, Inc.	239
Tuttle & Bailey, Inc.	311
Typhoon Air Conditioning Co., Inc.	623-625
United Electric Service Co.	425
U. S. Air Conditioning Corp.	819
U. S. Radiator Corp.	429-431
Utility Appliance Corp.	807
Verson Mfg. Co., The	618
Viking Mfg. Corp., The	347
Vulcan Radiator Co., The	320-322
Waterman-Waterbury Co., The	244
Webster Electric Co.	229
Webster Engrg. Co., The	455-457
Weil-McLain Co.	250
Westinghouse Electric Corp.	725
White-Rodgers Electric Co.	606
Worthington Pump & Machinery Corp.	312-314-411-413
Yarnall-Waring Co.	802
York Corp.	736-740
Zink Co., John	609
Zone Heat Regulator Co.	412

PROGRAM OF 56th ANNUAL MEETING

AMERICAN SOCIETY OF HEATING AND VENTILATING ENGINEERS

• Hotel Adolphus and The Baker Hotel, Dallas, Tex. •

Hotel for Each Event Indicated in Parenthesis

Sunday – January 22

10:00 a.m. Committee on Research (Baker)

10:30 a.m. Council (Adolphus)

4:30 p.m. Chapter Delegates (Adolphus)

Monday – January 23

9:30 a.m. First Session (Baker)

Night-Air Cooling, by F. E. Giesecke

Physiologic Examination of the Effective Temperature Index, by Nathaniel Glickman, Tohru Inouye, R. W. Keeton, M. K. Fahnestock

Amendment of By-Laws

12:30 p.m. Welcome Luncheon (Adolphus)

2:30 p.m. Chapter Delegates (Adolphus)

7:00 p.m. Chuck Wagon Dinner Party

Tuesday – January 24

9:30 a.m. Technical Session (Adolphus)

Thermodynamic Criteria for Heat Pump Performance, by John F. Sandfort

Evaluating Heat Pump Performance, by F. R. Ellenberger, A. B. Hubbard, W. R. Foote, F. Burggraf, J. J. Martin, Jr.

Condensation on Prefabricated Walls, by E. R. Queer and E. R. McLaughlin

12:30 p.m. Luncheon Meeting (Adolphus)

2:00 p.m. Chapter Delegates (Adolphus)

6:30 p.m. Past Presidents' Dinner (Adolphus)

Wednesday – January 25

9:30 a.m. Technical Session (Adolphus)

Solar Heating of Houses by Vertical South Wall Storage Panels, by A. G. H. Dietz and Edward Czapek

Removal of Lighting Loads by Panel Cooling, by Merl Baker

Baseboard Radiation Performance in Occupied Dwellings, by G. S. MacLeod and C. E. Eves

2:00 p.m. Technical Session (Adolphus)

Report of Committee on Research

Panel Heating Research Report on Experimental Techniques and Results of Heat Flow Within a Concrete Panel and Heat Flow Analysis for Buried Pipes

Effect of Panel Location on Skin and Clothing Surface Temperature, by L. P. Herrington and R. J. Lorenzi

7:00 p.m. Annual Banquet (Baker)

Speaker—Dr. Umphrey Lee, President, Southern Methodist University

Presentation of F. Paul Anderson Medal to Dr. C.-E.A. Winslow

Thursday – January 26

10:00 a.m. Technical Session (Adolphus)

Resistance Gradients Through Viscous Coated Air Filters, by F. B. Rowley and R. C. Jordan

Fitting Losses for Extended Plenum Forced-Air Systems, by H. H. Korst, N. A. Buckley, S. Konzo, R. W. Roose

Vaneaxial Fan Fundamentals, by Raymond Mancha

Society Business

Resolutions

Installation of Officers

12:30 p.m. Nominating Committee Luncheon (Adolphus)

12:30 p.m. Council Luncheon (Adolphus)

ABSTRACTS OF PAPERS TO BE PRESENTED AT DALLAS

Resistance of Viscous Coated Air Filters

A method has been devised for quantitatively measuring the resistance gradients through unit types of filters having packs of reasonable thickness and of such nature as to be readily severed. Five different types of filters were subjected to a variety of tests and the results presented by Frank B. Rowley and Richard J. Jordan, respectively, director, Engineering Experiment Station, and professor of mechanical engineering, University of Minnesota, in a paper on "Resistance Gradients Through Viscous Coated Air Filters."

The filters selected, the dusts used, and the tests conducted were chosen to provide a range of combinations broad enough to indicate of the value of this type of analysis and to show the typical results that can be expected.

Results of the tests indicate that heavy loading of the dust in the filtering medium frequently occurs at some point ¼ to ½ inch depth. Location of this localized high resistance gradient will vary depending upon the nature of the filtering medium and the test dust used. Lint normally deposits toward the entering surface of the filter and therefore causes localized high resistance gradients at such points. Finely divided carbonaceous dusts deposit more heavily in the more efficient dust filtering areas usually located toward the discharge size of the pack. Such dusts cause high localized resistance gradients in such sections. Other dusts cause steep gradients at intermediate sections.

Conditions were encountered in which, at the end of the test, as much as 75% of the total resistance of the filter could be attributed to localized resistance within a ¼ inch depth of the filtering medium.

Once a condition of a high localized resistance gradient has developed within a filter, the dust deposits in this section become progressively heavier and in turn result in progressively steeper gradient at this section.

The authors suggested this type of analysis as a laboratory test and possibly a field test.

Relation of Panel Location to Skin Temperature

Information on "Effect of Panel Location on Skin and Clothing Surface Temperature," was presented in a paper by L. P. Herrington and R. J. Lorenzi, respectively, director of research, and research engineer, John B. Pierce Foundation, Laboratory of Hygiene. Tests were conducted to find what effect location of radiant heating panels had on the human body. Tests of five days each were conducted on the effect of floor heating and also ceiling heating conditions.

One of the primary conditions of thermal comfort is a skin temperature ranging from about 80F on the toes and soles of the feet to about 95F on the trunk and certain facial areas. The overall average for the skin surface is from 90-92F.

The following four conclusions were drawn from the studies made and the tests conducted:

1. At room center black body temperature of 75F, radiant floor panels operating at 79F produce a pleas-

ant increase in the temperature of the clothing surface of the lower extremities. Under such conditions, the gradient between extremities and environment is increased about 28% over comparable heating with ceiling panels operating at 95F.

2. Foot temperatures under comfortable conditions requiring no house heating are about 10F above shoe surface temperatures which are nearly 74F when floors are at 71F. Other surfaces and air temperatures are within 3F of this value.

3. Physiological considerations are reported which support the view that floor temperatures above 75F are not desirable.

4. Since ceiling location of the radiant panel does not produce a significant effect on head temperature, this location for a radiant panel is preferable to the floor location.

The authors stated that it is highly probable that floor temperatures above 75F are physiologically undesirable and that 80F can be taken as the level at which the local effect of floor heating is clearly demonstrable in the lower extremities when contrasted with ceiling location for the radiant panel.

Vaneaxial Fan Fundamentals

Characteristics of vaneaxial fans and the factors affecting the design of such fans were discussed in a paper on "Vaneaxial Fan Fundamentals," by Raymond Mancha, vice president, Joy Manufacturing Co.

In addition to providing explanations of how the various parts of the fan function—rotor, vanes, blades, and the use of multi-staging—equations and design curves are included to help the designer in obtaining a quick analysis of design possibilities for a given fan duty. Mr. Mancha included design curves for vaneaxial fans with and without discharge stack.

The design curves included are based upon a design procedure that strikes a practical balance between fan efficiency, speed and experimentally established permissible hub loadings. These curves, which disregard the effects of hub windage and bearing losses, show that high fan efficiency and low tip speed can be incorporated in the same design. Both are best effected with large, slow fans of low design unit volume and high hub ratio.

With vaneaxial fans, it is possible to adjust the blade setting, thereby altering the fan's characteristics to suit changing pressure-volume characteristics of the ventilation system. Within a limited range of angles, the blades continue to operate satisfactorily with stationary unaltered guide or straightener vanes.

Heat Pump Performance

John F. Sandfort, professor of mechanical engineering, Iowa State College, in his paper "Thermodynamic Criteria for Heat Pump Performance," examines the functioning of the heat pump as a thermodynamic apparatus.

The heat pump operates with certain variables in design conditions which include types of fluids being circulated, the temperature of the fluids leaving the apparatus, and the temperatures of the reservoir and the space to be heated.

Prof. Sandfort states that according to experience, the practical way to design and operate a heat pump is as a steady flow apparatus in which fluids enter and leave the equipment with falling or rising temperatures. The amount of temperature change in these fluids depends on their mass rate of flow which in turn are limited by factors such as permissible air changes, friction drop, noise, circulating fan and horsepower.

The minimum conceivable work required to change the state of these fluids between specified limits can be evaluated, he pointed out, by calculating their change in availability.

In this way, a relatively simple method can be used for evaluating the performance for the various ideal and operating heat pump cycles of common engineering installations. Such an evaluation, it was mentioned, will show that the ideal simple vapor compression cycle falls far short of the maximum theoretical coefficient of performance. Various complex vapor compression cycles show considerable improvement in this regard, and the maximum possible coefficient of performance by certain ideal air cycles. A study of a number of such cycles has been made.

Condensation on Prefabricated Walls

Forty-four samples of prefabricated walls were exposed to various weather conditions to obtain data regarding condensation on prefabricated walls used in small, tightly constructed dwellings. Methods followed in conducting the tests and the results obtained were included in the paper on "Condensation on Prefabricated Walls," by E. R. Queer and E. R. McLaughlin, respectively, professor of engineering research and associate professor of engineering research, Engineering Experiment Station, The Pennsylvania State College.

These tests indicated that in prefabricated construction, the use of materials having low resistance to heat transfer should be avoided. While panels frequently met all requirements for satisfactory walls, condensation occurred on the interior surface near a metal stud or a returned edge of an exterior metal sheet.

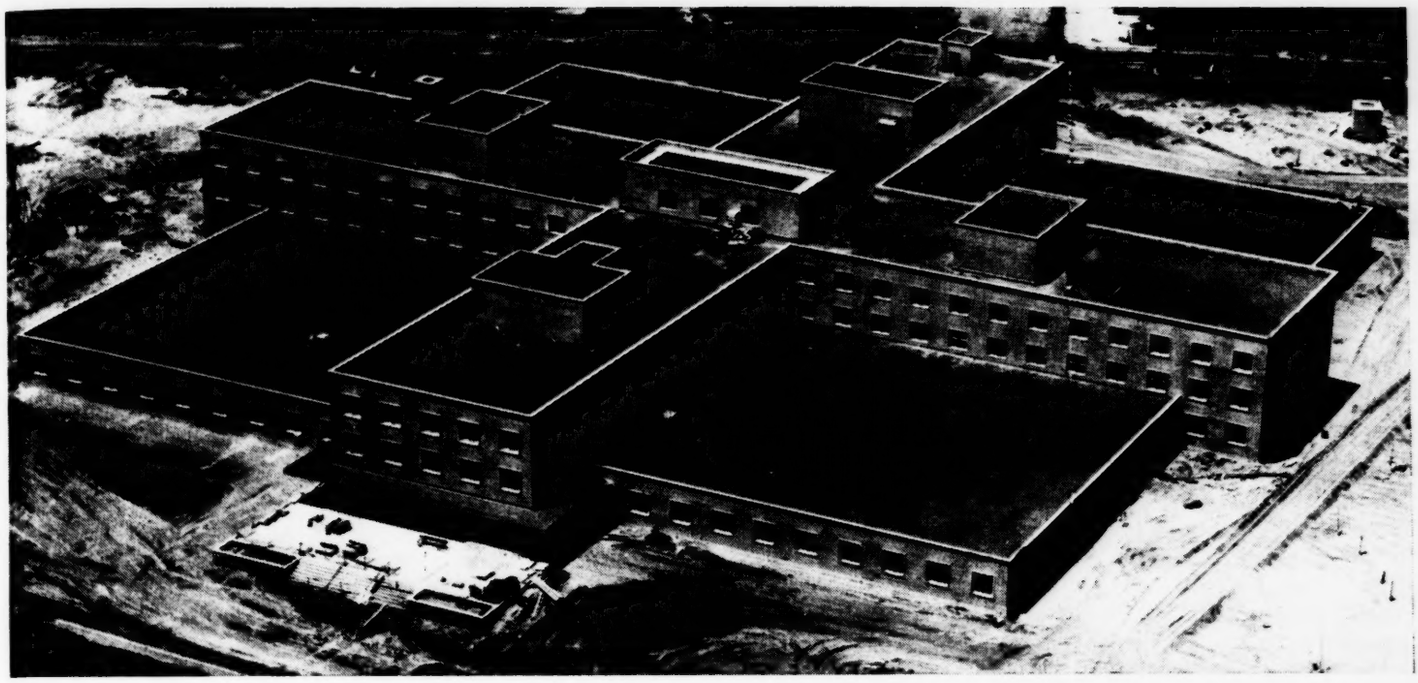
The advantages of a metal exterior are frequently offset by the undesirable accumulation of condensation. In a measure, this can be overcome by adequate ventilation from the weather to the wall cavity.

Emphasis was placed on the importance of a good vapor barrier well applied to the warm side. Plywood served as a good vapor barrier, particularly when it was given several coats of a good oil paint. Walls with metal panels as the interior finish were very resistant to vapor flow.

The joints between fabricated panels frequently represent an area of condensation. Where bolts or metal strips are used through metal, contact points present a cold surface to the humid air.

Use of organic materials which encourage the growth of mildew and fungus under favorable conditions is to be discouraged. With relatively short exposures to favorable conditions, such materials show stains and fungus growth.

(Abstracts to be concluded in next issue)



Federal Building at Idlewild Airport

Conditioning of Airport Facilities

FRED G. HAMBURGER
Guy B. Panero, Engineers

All facilities for two Government agencies, the Civil Aeronautics Authority and the Weather Bureau Regional Office, will be housed in an air conditioned office-warehouse-garage building at the New York International (Idlewild) Airport. The building represents the ultimate in equipment and controls as set forth in the following description.

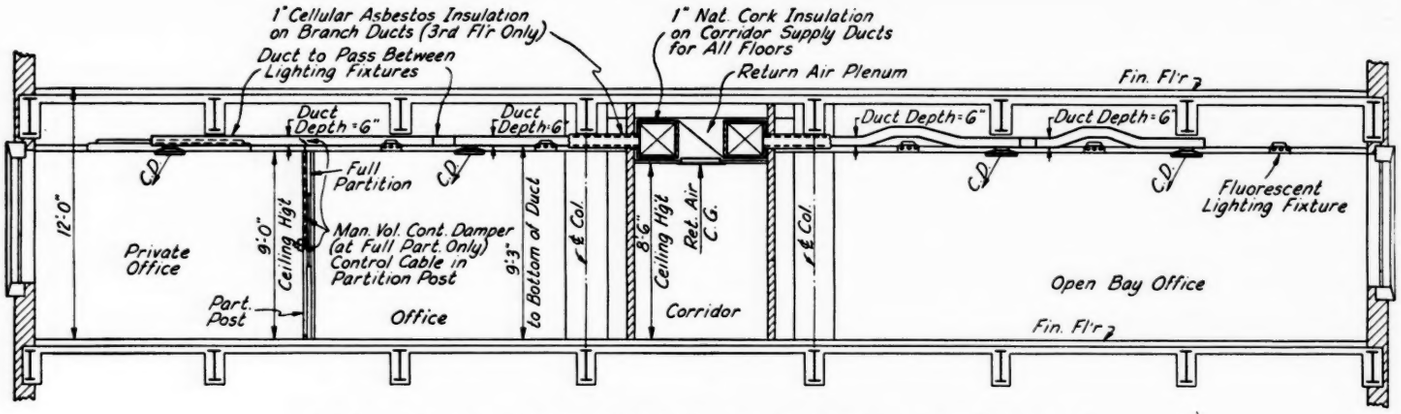
THE new Federal Building, recently completed at the New York International (Idlewild) Airport, will provide complete facilities for two United States Government agencies. The building was constructed by the Port of New York Authority which will lease it to the Public Buildings Administration for occupancy by the Civil Aeronautics Authority and the Weather Bureau Regional Office. It is located on a 10-acre site at the northern boundary of the airport and will provide space for approximately 500 employees. In addition to 90,000 sq ft of office areas, facilities will include approximately 75,000 sq ft of diversified warehouse and maintenance space, a 70-car garage, a cafeteria for 250 persons, complete with full kitchen facilities, and a central boiler room and service area.

The building, which is of steel, concrete, and brick fireproof construction, is three floors high with the lower floor in the form of a square approximately 370 ft on a side and the upper two floors in the form of a cross superimposed on the first floor. The upper floors are devoted to office space with the lower floor given to additional office space, the cafeteria, garage and warehouse. The building, since it is within a few hundred yards of a runway, was designed as low as possible, and of course must spread out to provide the required area.

Architectural plans were by Reinhard, Hofmeister & Walquist. The firm of Guy B. Panero, Engineers, was commissioned to provide complete mechanical and electrical plans including such diverse items as heating, ventilating and air conditioning, elevators, plumbing and sprinkler systems, kitchen, lighting, power and communications. All plans were prepared under the general supervision of Todd and Brown, Inc., who also supervised construction and coordinated the project. John M. Kyle, Jr., chief engineer of The Port of New York Authority, directed the program.

Planning, before submission of designs, required basic decisions which affected structural and architectural design and cost. These included central corridors on all floors the full length of both building axes and approximately 8 ft wide permitting the use of light beams (4-column construction). Under these beams were located the large ducts of the air conditioning systems on the second and third floors and the major part of the heavy and extensive piping on the first floor. Bays on each side of these corridors were approximately 26 ft wide.

The use of well water for cooling and condensing eliminated the need for heavy cooling towers and base supports. Four of the air conditioning fan rooms were located on the roof of each wing at the center where duct runs would be smallest, since mains split immediately upon reaching the floor served. This arrangement simplified architectural planning.



Section of wing of Federal Building showing branch take-offs for air conditioning in office areas

A scheme which provided two conditioned air supply outlets per bay off the corridor main duct at the quarter points provided flexibility for tenant changes, which, contrary to custom, occurred both before and after completion of the contract plans. This scheme also fitted in well with window locations of two per bay and in general with the fluorescent lighting scheme.

Although it was first intended to use side wall supply outlets, it was later decided to install ceiling diffusers. Cost studies showed an acoustical tile hung ceiling would effect considerable savings through the elimination of certain finished plaster work.

The use of a return air plenum in the hung ceiling of the corridors only on the second and third floors reduced the cost of ductwork and provided added space for lighting and piping. Since all spaces surrounding these plenums are air conditioned and under a normally positive pressure, leakage was not considered as important. The return air from conditioned spaces passes into the corridors through wall louvers provided with fusible links as a fire precaution.

The roof over conditioned areas only on the first and third floors has two inches of insulation.

Panel heating with floor coils was planned for the main entrance lobby to give the entrance a clean architectural appearance. This lobby, which is glass enclosed on three sides and can be seen in full from the outside, is also air conditioned.

All of these basic major considerations and decisions were formulated before design was started and with only the broad architectural scheme available as a basis. They are mentioned merely to emphasize the necessary thrashing out of fundamentals before actual design work begins.

Air Conditioning Systems

Air conditioning is provided for comfort in all office areas, the lobby, cafeteria and dining room, and the telephone switchboard room. The basic considerations already discussed and the shape of the building indicated the desirability of unitary systems served by a central refrigeration plant providing chilled water. Thus, each of the four wings of the building on the upper two office floors is provided with a central fan system located on the roof at the center of the wing. Each system has a capacity of approximately 26,000 cfm and supplies cooled and dehumidified air to the upper two floors of the wing. Vertical ducts split two ways on each side of the corridor at each floor and by this arrangement four independent zones are provided. A zone constitutes one-half of the floor on each side of the long axis of a wing and reflects the exposure of its face of the wing. Thermostats for each zone control are located on an inside column in an open bay area which will provide a reasonable average temperature.

Two branches per bay off the corridor duct supply, in general, four ceiling diffusers per bay modified in some cases by local conditions.

For the many outside private offices it was, of course, impractical to provide accurate zone control and as a result branches to each of these spaces were fitted with volume dampers of the multi-blade type subject to the desire of the individual occupant. Special executive offices and conference rooms, however, were provided with fully automatic thermostatically controlled volume dampers. All of these offices, in turn, are subject to the overall zone control of the portion of the wing in which they are located. Since these volume controls affect not more than 10% of the total volume of the supply air delivered, it was considered that even with a large proportion in use there was no danger of upsetting the overall system controls. It was agreed that temperatures within the private offices could vary two or three degrees from the zone setting.

A similar system of 11,000 cfm capacity located on the 1st floor and with two major zones serves the office area on the east side of the building and the entrance lobby. Another system of 11,000 cfm capacity, also located on the first floor, serves the cafeteria and has separate zones for the cafeteria and an executives' private dining room. This latter system delivers approximately 40% of outside air during the cooling season to offset in part the range hood and other kitchen exhaust points. Exhaust of excess air from cafeteria and dining room to the kitchen areas is through a large louver opposite the range hood and will provide some cooling to the kitchen area. The other systems provide the conventional 20% of outside air designed to maintain the desired positive pressure in the conditioned areas.

A seventh fan system of only 1,500 cfm capacity serves an isolated telephone switchboard room and for practical reasons utilizes 100% outside air. This system and the others described comprise a total of 21 independently controlled zones.

The apparatuses for the six larger systems are of conventional design and arrangement. The assembly consists of a backward curved, non-overloading supply fan, a prefabricated dehumidifying and cooling unit, and a bank of throw-away type filters. Upstream of the dehumidifier is the preheat, non-freeze type, coil for use in winter with minimum outside air. Downstream of the fan are the reheat coils, also of non-freeze design, serving and controlling the various zone temperatures.

Two features of interest are seen in these apparatuses. Provision is made for future installation of carbon odor absorbers in the event this becomes necessary. This precaution was based primarily on the possibility of odors from the mud flats of Jamaica Bay and a nearby sewage plant adjoining the airport. When weighed against the cost of providing the small space for these units, the precaution was deemed advisable.

The second feature of interest is the use of a 6-row precooling coil in the dehumidifier unit and a 4-row dehumidifying coil in series. Though well water is available at approximately 53F, the precooling coils are designed for 60F in the event the well water temperature rises in the future due to possible heavy usage of underground water in this area by others. It is expected that this coil will do the major part of the cooling job through the summer season. These coils are also sprayed to obtain the maximum effect from the well water. The dehumidifying 4-row coil is supplied with chilled water at 48F from the central refrigeration system.

Air Conditioning Controls

The control system for year-around air conditioning is pneumatically operated and is designed to provide automatic control of temperature and humidity. The only manual operation is the use of the summer-winter converting switch for the changeover between seasons. This is usually done by the operating engineer at the start and finish of the summer cooling season.

Automatic dampers in each apparatus room allow the use of all outside air as an economy measure. When operated this way no refrigeration is required to maintain desired space conditions. During the summer season the minimum outside air and return air dampers only are operable. During the winter season the maximum outside air and relief air dampers will open gradually and the return air damper close gradually on a temperature rise and the reverse on a fall.

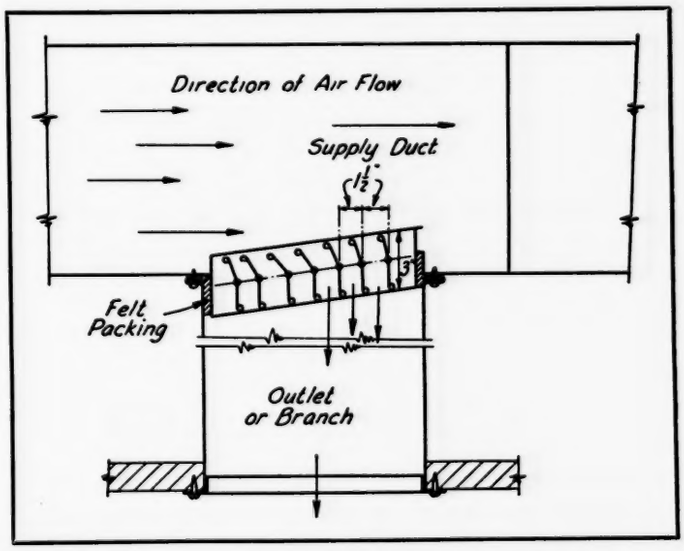
A master thermostat located in the minimum fresh air intake upstream of the precooling coil resets the control points of all zine thermostats within a range of approximately 10 degrees in order to reduce extremes between outside and inside conditions.

During the summer cooling season the steam valve to the preheating coil is of course kept closed by a thermostat down-stream of this coil. This thermostat also acts as a low limit control in the winter season. The individual zone thermostats, on a rise in temperature, will, in sequence, close the reheat coil steam valve, open the precooling coil (well water) valve, and the dehumidifying coil (chilled water) valve. The water valves are the three-way type, damper motor operated, and are so controlled to provide full flow of the well water for maximum effect before the chilled water is used. These valves function similarly in answer to the humidistat located in the common (to all zones) return air duct. When a zone tends to overcool, the zone thermostat will gradually open the reheat coil steam valve.

The system described is designed to provide, as is customary in this area, inside space conditions of 80F D.B. and 50% R.H. when outside conditions are at 95F D.B. and 75F W.B. The importance of proper location of theromstats or humidistats cannot be overemphasized.

Well Water System

Since all plans for the use of well water have somewhat the nature of a gamble, whether it be temperature or quantity, a thorough investigation was made beforehand to reduce this risk. A check of various water utilities operating wells in the area indicated that temperatures as low as 52F and quantities up to 1,000 gpm could be obtained with depths up to 400 ft. As a result, two successful wells were drilled which delivered water at the required 200 gpm each and at 53F. These wells, 105 ft deep, are located 100 ft apart at the northwest side of the building and are equipped with pumps of the multi-stage vertical turbine type housed in separate brick buildings. The wells are of artificial gravel, filter wall type, double cased, and were developed by the hydraulic surging method. Two diffusion wells, which are similar to the supply wells except that no pumps are used, were also drilled to conform to the requirements of the New York State Water Power Commission, and are located more than 500 ft from the south side of the building and are 60 ft apart. The normal flow of underground water in this area is generally north to south. All well water is delivered throughout the building by the supply well pumps to six of the air conditioning systems for pre-cooling and thence to the condensers of the refrigeration cycle. The discharge from the condensers is then



Schematic detail of adjustable vane branch take-off.

brought up to the roof level before being piped to the diffuser wells in order to provide sufficient head above the diffuser wells.

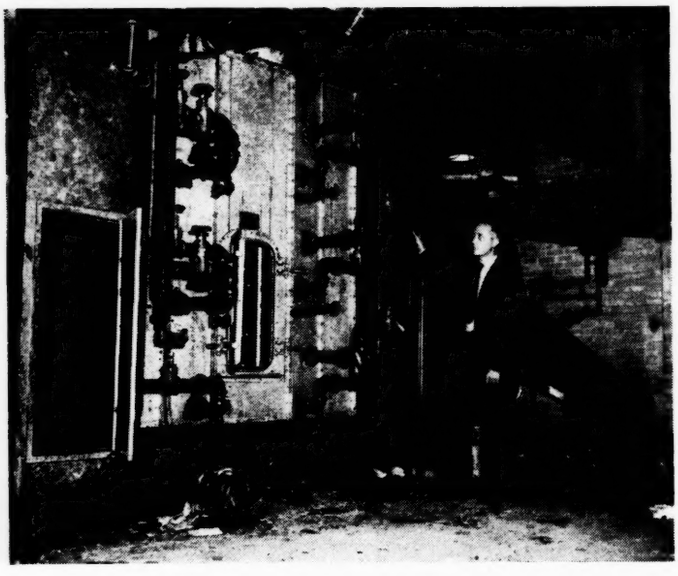
Piping between the supply and diffuser wells and the building is run underground and is of cast iron, with bituminous enamel inside and out. Protection is provided thereby against possible salt water corrosion outside, since the water table is close to the pipe and subject to Jamaica Bay tidewaters, and also inside against the formation of rust tubercles which may form in this area on unlined pipe. The well water is, of course, not affected by the salt water since it is pumped from a stratum of sufficient depth. However, some experience in this area indicates that when pumping rates over 400 gpm per well are used, depending on depth, brackish water may be drawn in. Condenser water temperatures were also limited to 90F or less since the iron content of water at the stratum selected may precipitate out at temperatures above this point.

Both supply wells may be operated by remote control push-button from the engineer's office and are provided with water flow meters and water level depth gages for accurate check of well conditions. The total well water supply is designed to give an equivalent refrigeration capacity of more than 150 tons.

Though cost of the entire well water system including piping was only slightly less than the same capacity of mechanical refrigeration, the operating cost is expected to be only a fifth of the other, based primarily on their respective horsepower requirements, 30 hp for the well pumps and approximately 150 hp for the equivalent mechanical refrigeration.

Heating Systems

The steam heating system for the office areas on the second and third floors is a conventional two pipe upfeed vacuum system with all returns on the first floor ceiling pitched back to a duplex vacuum pump and tank unit at the south side of the building. Sectionalizing valves on the supply mains provide shut-off for maintenance of convectors on each face of each wing, thus providing that no wing need be more than half shut down for maintenance in winter. Because of the spread-out design of the building, the maximum return main run was over 300 ft, which emphasized the need for careful pitching of the returns.



Apparatus room on roof with cooling coil connections prior to insulation.

This system is provided with temperature control for two zones, which splits the building into two parts along the "north-south" axis, though the zones are generally north and west and generally south and east. The system is electrically operated with central control of the two supply mains by means of throttling steam valves located in the boiler room and subject to an outdoor thermostat. Each convector is provided with a metering orifice. Space conditions, designed for 70F, can be modified by a manually reset control.

The heating system for the first floor office and cafeteria area is similar to the above, but these areas are controlled by pneumatically operated modulating plug valves. Returns from radiators on these systems run in a crawl space under the first floor.

Featured in all of the aforementioned systems are more than 250 specially designed steel convector enclosures. These were designed in cooperation with the architect to fit the 6-ft window width and to provide an enclosure that would stand up under rough use without sagging. In addition, the enclosures provide a continuous base line and leave the floor unobstructed for easier cleaning. Special executive areas were provided with architecturally treated wood and steel enclosures.

Only brief mention need be made of the heating for the other areas which in general is provided by low pressure steam, with gravity return to a condensate tank in the boiler room. The vacuum pumps of the other systems return to this same condensate tank, from which all returns are in turn pumped to the boilers.

The garage, warehouse and loading platform are heated by thermostatically controlled unit heaters, which are mostly of the projection type fitted with cone diffusers.

The garage, which is heated to only 55F, is also provided with a tempered ventilating system providing more than four air changes per hour. Two unit ventilators supply air at the south end and it is exhausted by propeller type fans at the north end. Garage, warehouse and loading platform are all equipped with sprinkler systems.

The main entrance vestibule, which is provided with three double doors, is heated by a recirculating forced air system. Air is supplied by a remotely located 1,000 cfm unit ventilator, at a temperature of approximately 125F, to three ceiling grilles over the space between the double doors. Air is returned through specially designed vertical louvers at each side of the furred columns in this space. The corridors at two of the other three building entrances are heated by means of unit heaters located just inside the door and in the hung ceiling with a recirculating grille adjacent to the heater. These are designed primarily to avoid the effect of occasional cold drafts.

Fan rooms and a special laboratory, all located on the roof, are heated by cast iron wall hung radiation connected to separate risers for that purpose.

The main entrance lobby is provided with a full area, sinuous coil type, radiant panel buried in the floor. As mentioned previously, this scheme was planned in cooperation with the architect. The coils, of one-inch wrought iron pipe, are buried in a three-inch concrete slab, resting on a protective coating for the two inches of foam glass insulation, and in turn on the structural concrete slab. Above the coil slab is a setting bed for the heavy 2½-inch decorative flagstone.

Water is supplied from a converter located in the boiler room area. Control is provided for this system by a space thermostat and an outside thermostat which operates a three-way valve to vary the proportion of hot water or return water to the panel. The outside thermostat is designed to have three times the authority of the space thermostat. The steam supply valve to the converter is controlled by a thermostat in the water discharge pipe and maintains a maximum temperature in this line.

In addition to the garage, ventilation is provided in the general area of the maintenance and engineer's office, the main switchgear room, and several special centrally located areas, in accordance with good practice. This air is tempered in winter.

Exhaust ventilation, with the New York City code as a minimum, is also provided for all toilet, shower, and locker room areas, the refrigeration room and a special paint storage room.

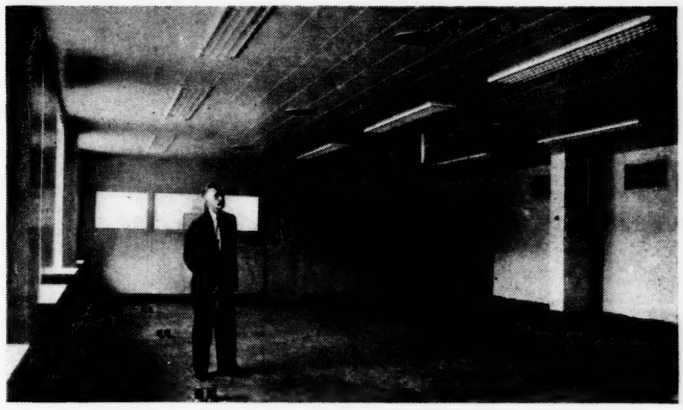
Supply and exhaust ventilation in general is provided by means of ceiling hung unit ventilators with thermostatic control and utility type centrifugal exhaust fans. Fully housed copper roof exhausters are, in general, used for toilets, showers and locker rooms.

Boiler Plant

The steam generating and refrigeration plants are located in separate rooms on the first floor of the south wing. The boilers, return tanks, and pumps are at an elevation four feet below the remainder of the first floor to provide added height at the boilers.

Three low pressure, high firebox, steel boilers are provided. They have a S.B.I. steam rating of 15,180 sq ft, or the equivalent of approximately 50% of the full steam load. They will be operated at from two to five pounds per square inch gage pressure.

Oil firing was selected as most suitable at present for these units, but provision has been made for future coal stoker firing by an increased height of setting, sufficient space in front for stokers, a trolley hoist for coal and ash handling, and a coal storage space adjacent to the boiler room. Gas was also considered for fuel, but discarded as too remote from a supply standpoint. The oil burning and handling system is completely automatic, with single burners of the horizontal rotary cup type per boiler, and all necessary accessories for control and safety. Two motor driven rotary pumps, one a spare, feed No. 6 heavy oil from two 10,000 gallon storage tanks, a supply sufficient for approximately three to four weeks of winter weather. The tanks are enclosed in a separately walled-in room in front of the boilers and accessible only from the outside wall of the building to conform to fire underwriter's requirements. Heating of these tanks is by a separate hot water system.



Office area with radiation under windows and ceiling diffusers.

A separate 100 pound A.S.M.E. rating miniature boiler of the all steel vertical type, automatic gas fired, with a capacity of approximately 400 pounds per hour, furnishes steam at approximately 50 pounds for kitchen use only. All boilers discharge their gases into a common stack, 60 ft high above the boiler room floor, with the breeching connection at the stack for the gas fired unit lower than the connection for the oil fired units, to insure non-interference of draft for the small unit. All controls for operation of all the boilers are located within sight of the operator. A completely automatic duplex pump and tank unit is located in the kitchen area and serves as both a condensate return collector and boiler feed pump for the high pressure kitchen boiler.

Refrigeration System

A complete refrigeration plant is located adjacent to the boiler room and has a total capacity of 180 tons at 40F suction, 90F condensing temperature, with water for condensing at not less than 70F. Three 60-ton reciprocating, Freon-12, units are driven by 50 horsepower refrigeration duty motors with 150% rating multiple V-belt drives. Each unit operates integrally with its own condenser and dry expansion type water coolers. Control of these units includes 50% capacity by-pass per unit and sequence operation to provide one sixth of total load. Expansion valves with a capacity of 60 tons each are of the piston actuated type. The well water supply to the condensers is provided with a by-pass relief valve at each condenser and a throttling valve. The throttling valve is controlled by the discharge gas pressure to prevent low head pressures. Two single stage, double suction, centrifugal pumps, one a spare, with a capacity of 435 gpm each, complete the system.

Alarm System

In the engineer's office, centrally located on the first floor, are various alarm boards used in supervision, maintenance, and safety operations of the building.

These boards include a mechanical equipment alarm board which gives both audible and visual signals of the functioning of all air conditioning, ventilating and exhaust fans, the thermostatic control air system, low water in each boiler, and low water in the chilled water expansion tanks.

Events at the ASRE Convention

An account of what happened at the Chicago convention of the American Society of Refrigerating Engineers, and abstracts of papers presented at the technical sessions.

THREE conferences of special interest to the refrigeration field proved to be one of the outstanding features of the 45th annual meeting of the American Society of Refrigeration Engineers that was held at the Edgewater Beach Hotel, Chicago, December 4 to 7. The conferences covered such timely topics as water re-use, the room air conditioner and the domestic refrigerator and were well attended. Total convention attendance was about 650 persons.

The convention accepted two standards—Standard 16R on Methods of Testing and Rating Room Air Conditioners; Standard 23 on Testing and Rating Refrigerating Compressors.

The new officers are: President, J. G. Bergdoll, Jr., York Corp., York, Pa.; Vice President, Paul B. Christensen, chief engineer, Merchants Refrigerating Co., New York, N. Y.; Vice President, Edward Simons, consulting engineer, San Francisco, Calif.; Treasurer, Richard C. Jordan, professor of mechanical engineering, University of Minnesota.

Awards

R. M. Buffington (deceased) late engineer with Servel, Inc., received the posthumous award for the best section paper. His paper was "Qualitative Requirements for Absorbing Refrigerant Combinations," given before the Indiana section.

The Wolverine award for the best paper published in *Refrigerating Engineering* was presented to Milo M. Bolstad, associate professor of mechanical engineering, University of Missouri and Richard C. Jordan, professor of mechanical engineering, University of Minnesota for their paper, "Theory and Use of the Capillary Tube Expansion Device."

Coming Conventions

Dates have been set for the 1950 spring and winter conventions. The spring convention is scheduled for June 4 to 7, Hotel Muehlebach, Kansas City, Mo. The annual convention will be held December 3-6, Hotel Commodore, New York City.

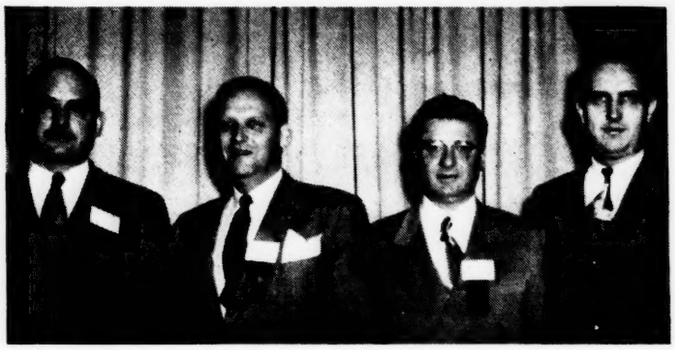
Following are the abstracts of some of the papers presented at Chicago.

Water Demand for Refrigeration

Edward L. Bean, Principal Assistant Engineer, Philadelphia Bureau of Water, Philadelphia, Pa., spoke on "Refrigeration and the Problems of the Water Supply Industry."

In the United States, the per capita investment in water works averages $58 and the average per capita water bill is less than $8 a year. Per capita cost of needed facilities averages about $60 per capita for the nation's entire population.

Study of the water being used in Philadelphia indicates that should all refrigeration units in the city become unconserved, at the present rate of development, such units would, by 1970, be passing on hot days a total amount of water per day equal to the present average daily use for the entire system. However, if only 60% conservation was practiced by 1970, the water demand would be about 45% of the present daily average for the entire system.



New ASRE officers are, left to right, President, J. G. Bergdoll, Jr.; Vice President, Paul B. Christensen; Vice President, Edward Simons; and Treasurer, Richard C. Jordan.

There is an interdependence of water and sewage service, for as the water demand is increased, so too is the load placed on the sewage facilities of the city. There are a great many cities were sewage facilities are inadequate and many municipalities have enacted ordinances to control the discharge of such water. For more than a year, a committee of the American Water Works Association has been studying the problem of water regulation.

While the shortages of water and overloading of sewers are not due alone to air conditioning, it is an important factor. The water works industry hopes that some means of conservation can be worked out with the refrigeration industry, while it is still timely. In many communities, water supplies are limited, so that early action must be taken to work out a satisfactory solution.

Constructive water conservation will encourage similar results in other aspects of water use. The author expressed the hope that the refrigeration industry would cooperate to make it possible for the water works officials to achieve a satisfactory solution to this most perplexing problem.

Water Quality Control

The problem of water quality control, as related to cooling towers, was covered by Ralph M. Westcott, a member of Pomeroy & Westcott, consulting engineer-chemists, Pasadena, Calif., in a paper on "Water Quality Control for Refrigeration Cooling Towers."

He stressed that the chemistry of the water to be treated must be adequately determined and periodic-

ally checked to be sure changes in composition have not occurred which were not anticipated or provided for in the treating program. It is impossible to establish any fixed combination of chemicals or water treating methods which will assure satisfactory results in all situations. Each system is more or less a special condition. Basic chemicals used under competent supervision will generally give more satisfactory and controllable results at far less cost than will the use of fancy-sounding proprietary remedies.

Materials or chemicals for treatment should be selected on the basis of their scientific value and proved record of success as well as their economic value. The person responsible for a water-treating program should have a sufficient knowledge of water chemistry to avoid being a victim of unscrupulous sales promotion of special treatments.

The author discussed algae and slime control, scale control and the problem of corrosion.

Turbulence Promoters in Evaporator Coils

The general effect of turbulence promoters on heat transfer rate and pressure drop for evaporating Freon-12 flowing inside horizontal tubes was covered in a paper on "Effects of Turbulence Promoters in Refrigerant Evaporator Coils." The authors are R. L. Larson, G. W. Quaint and W. L. Bryan, respectively, instructors and assistant professor, department of mechanical engineering, Case Institute of Technology, Cleveland, Ohio.

The study was undertaken to determine the heat transfer rate and pressure drop resulting from the use of a spiral spring type turbulator in $\frac{5}{8}$ inch O. D. copper tubing with Freon-12 inside the tubes.

As a result of this study, the following conclusions were drawn:

(1) A worthwhile increase in heat transfer was obtained by the use of spiral type turbulence promoters in Freon-12 flowing in horizontal refrigeration tubing.

(2) An appreciable, but not excessive, increase in pressure drop results from the use of spiral spring type turbulence promoters in Freon-12 flowing in horizontal tubing.

(3) Work should be done to determine the effect of turbulence promoters in systems already having a large degree of turbulence, that is, short tubes connected by return bends.

(4) Other types of turbulence promoters should be tested to determine if the spiral spring type is the most effective in Freon flow as it is in water.

Hilsch Vortex Tube

The Hilsch vortex tube has aroused considerable interest in this country and several types of hypothesis have been developed to explain its strange behavior by which cold air is discharged from one end of the tube at the same time that warm air is released from the other end.

A paper on "An Analysis of the Hilsch Vortex Tube," was prepared by D. S. Webster, Engineering Research Laboratory, E. I. du Pont de Nemours & Co., Inc., in which was presented results of a study of this tube.

In this tube, gas is introduced tangentially at high velocity through a nozzle so that there is a gas mass present in the tube, rotating rapidly. A portion of the total flow entering the tube is removed at the axis of rotation through a hole in the diaphragm that closes the end of the tube. This inward flow proceeds along a spiral path. The remainder of the gas leaves the entrance region by whirling off down the wall toward the throttling valve. The nozzle, orifice, and spiral path are in essentially the same plane, which is parallel and adjacent to the diaphragm.

Cold gas leaves through the orifice and hot gas through the throttling valve. When most of the air is leaving the cold pipe and only a small flow through the hot pipe, the temperature spread between the two streams may be as much as 250F.

Low Temperature Refrigeration at Kodak

A description of the —85F refrigeration system in operation at the Kodak Park plant of the Eastman Kodak Co., Rochester, N. Y., was presented by J. H. Shaw, refrigeration engineer of that company, in his paper on "Kodak Park's —85F Refrigeration System."

The present refrigeration system consists of two 375-ton Freon-12, two-stage units, each with two centrifugal compressors driven by steam turbines rated at 2,325 hp per machine. Each of these two machines occupies a building bay 22 by 36 ft with a basement 11 ft below the operating floor. In addition, at the present time, two duplicate machines are being erected to be in operation early in 1950. With these four machines, 195,000 gal of methylene chloride brine will circulate through nearly two miles of nickel-steel piping, 4 to 18 inches diameter, and at a rate of 6,900 gpm.

Savings with this new system as compared with the old —36F calcium chloride brine system exceed the anticipated return by showing greater solvent recovery than calculated. Other factors in favor of the —85F system are: Greater safety during production of the company's products, nearly complete elimination of toxic gases in the film production areas, and greater film machine speeds. All of these factors have resulted in the solvent condenser conversion program being set ahead about 18 months with the tentative completion set for early 1951.

Absolute Temperature

The "Last Hundred Degrees of the Absolute Temperature Scale" were described by Dr. Alexander Goetz, California Institute of Technology.

The most prominent thermodynamic quality of matter in the last 100 degrees is the specific heat, which is more or less constant at the higher temperature ranges. This decline in specific heat, which is rapid and converges towards zero, has provided basic information regarding the nature of heat energy in matter, in general, and in the solid state in particular. Knowledge of the temperature function of the specific heat in this range permits calculation of the entropy of many chemical substances and helps predict the most favorable temperature and pressure conditions in the field of chemical technology. Data

for a large number of chemical substances have been collected and catalogued for the sole purpose of deriving chemical equilibrium which cannot be measured at normal temperature level.

The electric and thermal resistivity of metals are less the lower the temperature and the purer the metal. The electric current passes the conductor without the development of heat and without a voltage drop. The heat conductivity increases in proportion with the electric conductivity for metals. At temperatures very close to the absolute zero, anomalies occur indicating a steep rise of the thermal resistance.

In considering the question of life at low temperature, Dr. Goetz stated that the higher the form of life, the smaller becomes the temperature tolerance.

The question of the utilization of low temperature phenomena brings up an important consideration. The most important contribution is the economic concentration of oxygen from the atmosphere. Another possibility is the use of liquid hydrogen as a lightweight fuel for jet and rocket propulsion since it is possible to obtain as much as four times more heat energy from the oxidation of hydrogen than from gasoline type fuels for the same weight.

It appears as if the last 50 degrees of the temperature scale will remain the most useful as a field of study in order to gather basic knowledge which can be applied to a better understanding and the refined control of the phenomena in the temperature range of the present environment.

Evaporative Condenser Performance Tests

In a paper on "Evaporative Condenser Performance Factors," by D. D. Wile, chief engineer, Refrigeration Engineering, Inc., Los Angeles, Calif., a method was presented for analyzing test data to obtain two empirical constants from which rating data could be derived for any desired operating condition. It is claimed that with this method, a smaller number of test runs can be used to obtain rating data over a wide range of condensing and entering air temperatures. Design data are provided that are of value in selecting the most economical combination of air flow, tube surface area, and water flow.

Mr. Wile described the test apparatus that was used to obtain operating data on an evaporative condenser and the test data to be plotted. He explained his recommended method for analyzing the test data.

At a reasonably constant air flow rate, the condenser rate performance can be established over a wide range of operating conditions by a by-pass factor Z and a coefficient U, either or both of which may vary with load but which are quite independent of other conditions.

He pointed out that there was need for basic heat transfer data that are applicable to evaporative condenser operation. This includes heat transfer coefficients from condensing refrigerant to tube wall, from tube wall through the water film to the wet surface, and from the wet surface to air.

Refrigerant Sampling

W. A. Pennington, Chief Chemist and Metallurgist, Carrier Corp., in his paper "Refrigerant Sampling," pointed out the difficulties that are part of proper sampling. He discussed techniques for obtaining a representative sample from static units, units with motion due to heat, and units with motion caused by a pump or compressor.

For sampling a simple tank or drum, the liquid is preferred and a recommendation made that a sample be taken immediately after the whole is shaken thoroughly.

Since it is possible to lose water in laboratory eqilibrium apparatus involving a refrigerant and a desiccant, any experiment designed to measure the capacity of a desiccant should be conducted so as to account for all water at the start and finish.

Refrigeration units containing a desiccant, especially the absorbent type, can be sampled so as to get a refrigerant which will give a measure of the water in the desiccant.

Cooling Tower Selection

Included in the group of papers on water problems that was presented at a Conference on Water Re-use was "Cooling Tower Selection for Refrigeration and Air Conditioning," by Howard E. Degler, technical director, The Marley Co., Inc., Kansas City, Kans.

He stressed that refrigeration equipment should be purchased for assured continuously satisfactory performance for the services required. This desire for good performance requires adequate capacity for the compressor, evaporator, condenser, water-cooling equipment and correlated items. High condensing pressures and temperatures generally result in unsatisfactory and expensive operation. Sufficient water-cooling capacity will assure low operating temperatures and good performance. The desire for effectiveness, for probable peak load service of the refrigeration equipment is particularly true for air conditioning installations for comfort cooling, although it is not usually as critical for commercial refrigeration.

Desiccants

Dr. Walter O. Walker, Ansul Chemical Co., Marinette, Wis., in his paper, "Desiccants—a Problem," set forth the problems and objectives of the ASRE Standards Committee on Desiccants.

A suitable desiccant must have the following properties: High efficiency, large capacity, high rate of action, high stability, non-corrosiveness, effectiveness both in liquids and gases, freedom from channeling, non-caking, low expansion or contraction, ready reactivation, of granular or porous structure. It must not dust unduly due to attrition or as the result of action of liquids of system; desiccant should have little temperature effect on efficiency, capacity or rate of action; besides being non-explosive, non-poisonous, non-irritant, it should have no chemical action on liquids of refrigerating systems or little heat evolution in use.

During the years in which desiccants have been employed in the refrigeration industry, about 40 different substances have been used or proposed for use.

At present the most important task is to set up acceptable procedures for testing.

STORAGE TANKS

for Fuel-Oil-Burning Installations

EVERETT F. OPPERMAN
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Storage Tanks for Fuel-Oil-Burning Systems

EVERETT F. OPPERMAN
Petroleum Heat & Power Co., Stamford, Conn.

A practical presentation of tank design and installation methods for fuel oil storage ranging from a typical domestic installation to industrial systems with burners having a firing rate up to 150 gph. Both inside and outside tanks are considered, and information included regarding tank gages.

AN oil-burning system is composed of many items, each of which will find itself under one of three major headings, involving the services of skilled mechanics specially trained in each field. The three major divisions are: (1) refractory furnace construction, (2) electric wiring and controls, (3) storage tanks and piping. While with all broad classifications such as this, there will of course be repetition, the grouping does serve to designate the principal trades involved.

The success of an oil-burning system is dependent upon careful planning and engineering, and the thorough execution of the work by the contractor and his mechanics. Special consideration must be given to the location of the storage tank with relation to the boiler room and fuel-burning equipment. Careless planning or poor judgment concerning this phase, can be responsible for a delinquent oil-burning system requiring a maximum of service and replacement of equipment, or the necessity of additional equipment such as extra pump sets, controls, and the general maintenance and cost of operating such required equipment.

Too often the storage tank location receives the last and least consideration. In many instances the tank is located at a very impractical distance from the fuel burning equipment. Also, it is necessary that the suction line receives considerable attention and care during installation. Leaking suction lines have been responsible for the failure of many oil-burning systems. These leaks are very difficult to locate and repair after the tank and piping have been buried. The suction line must be amply sized and run as direct as possible to the equipment it is supplying. The number of fittings in the suction line should be kept at a minimum.

Fuel oil storage tanks are generally of steel construction, although on rare occasions, concrete has been used. Steel is the most practical material for tank construction and tanks so constructed are by far the least expensive. Since steel has the most flexible characteristics, it is not limited by tank size, or the grade or weight of the fuel to be stored. It is thoroughly adapted to small domestic installations as well as to the largest industrial requirements.

There are definite rules and regulations covering the construction of fuel oil storage tanks. While local rules and regulations take precedence, where these are nonexistent, it is customary to install a tank constructed according to the National Board of Fire Underwriters requirements.

Concrete Storage Tanks

Concrete has been used successfully for the construction of bulk storage tanks, as well as for tanks of small and moderate capacities. At the present time, however, fuel oil storage tanks are almost exclusively of steel construction.

There are special rules and regulations for the construction of concrete tanks. The National Board of Fire Underwriters regulations states that:

(1) Concrete may be used as a material for storage tank construction when the fuel oil to be stored is heavier than 35 deg A.P.I.
(2) Selection of sites shall be governed by rules for steel tanks.
(3) All concrete tanks must be provided with a gas-tight concrete roof.
(4) Rules for piping shall in general be the same as for steel tanks.
(5) Plans for concrete tanks must be approved by the Inspection Department of the National Board of Fire Underwriters before the construction is started, and the entire erection must be under the charge of a fully competent engineer.

According to the Portland Cement Association, the maximum working stress of concrete in storage tanks should not exceed 8,000 to 10,000 lb. The concrete shall always be reinforced with steel, as concrete does not possess the strength in tension that it has in compression, and steel must, therefore, provide the tensile strength. Steel in tension in the walls and floor shall be designed for a safe working stress of 10,000 lb per sq in. whether in circumferential tension or in tension due to bending moments.

Tanks shall be designed to provide for all internal and external loads to include: (1) full hydrostatic pressure of contents upon floor and walls, (2) external pressure upon floor and walls, (3) earth pressure on walls, and (4) live and dead loads on roof.

Column loads shall be distributed over a proper area by providing adequate footings and floor reinforcements. The minimum thickness of walls shall be 8 inches at the top and 10 inches at the bottom.

Steel Storage Tanks

Steel tanks are constructed in three standard shapes now in general use, cylindrical, obround, and rectangu-

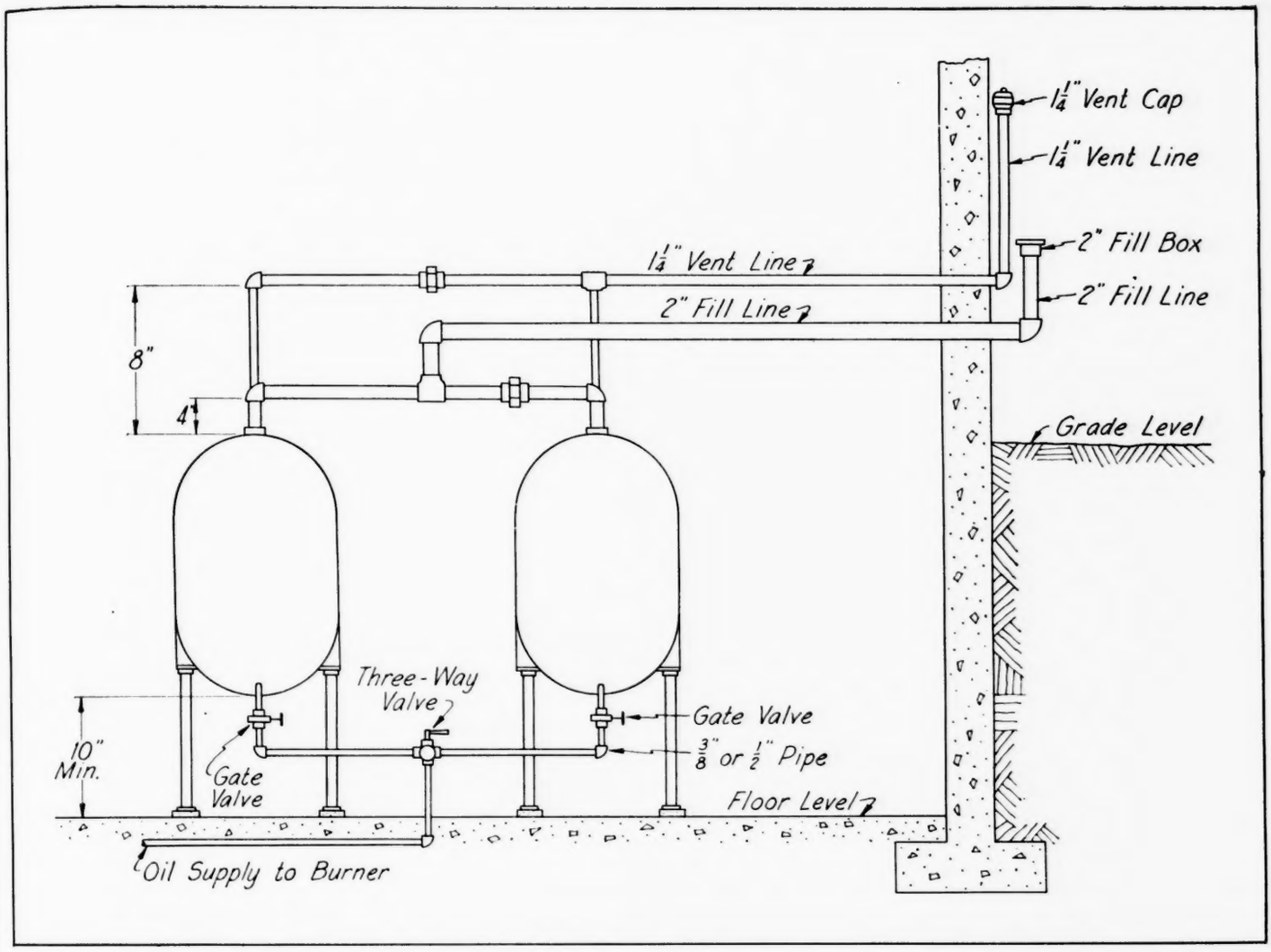


Fig. 1. A typical hook-up for two 275 gal basement tanks showing valves and pipe lines.

lar. Cylindrical tanks are always used for underground service. Large inside tanks are either rectangular or cylindrical. Where conditions require that tanks be fabricated on the premises they are generally rectangular in shape. Obround tanks are mostly used for domestic installations and are supported off the floor. They generally do not exceed 275 gal capacity.

Table No. 1 is a schedule of commercial sizes of cylindrical tanks for underground service built to National Board Standards.

Fuel oil storage tanks may be fabricated in the field, or in the basement or vault when outside space is limited. Tanks so fabricated are best constructed by electric weld, although acetylene weld is used when electric welding equipment is not available. If it is possible, the seams should be welded inside and outside; however, where conditions prevent this procedure, the welding may be limited to the inside seams. Rectangular tanks, it is recommended, should always be cross-braced internally.

The National Board of Fire Underwriters has set up the following minimum requirements for the construction of underground tanks and tanks inside buildings. Tanks of 181 to 275 gal capacity, installed in buildings without enclosure, shall be 14 gage minimum. Steel or wrought iron, thinner than No. 7 gage (3/16 or 0.188 in.), used in construction of underground and enclosed tanks, shall be galvanized. Otherwise, tanks shall be constructed according to Table No. 2.

If adequate internal bracing is provided, then tanks of 12,001 to 30,000 gal capacity may be built of ¼ in. plate. For tanks larger than 1,100 gal capacity, a tolerance of 10% in capacity is permitted.

Sizing the Storage Tank

The size of the fuel oil storage tank, or tanks, does not follow any single rule but is the outcome of: (1) the rate at which the fuel will be burned, (2) the space limitations available for storage capacity, (3) the availability or nearness of the sources of supply, (4) the method of delivery (by truck or tank car), (5) the possibility of transportation difficulties, and (6) the possibility of unit cost reduction on large purchases.

In sizing the fuel oil storage tank, it is first necessary to determine the rate at which the fuel will be consumed. Where the load is for heating purposes only, it is necessary to first obtain the annual fuel consumption. The greatest percentage of fuel consumption will occur in January and will amount to approximately 20% of the annual consumption. One-fourth of the January figure will give a week's supply which is the minimum tank size. Before selecting the tank, however, approximately 10% should be added to the minimum tank size to allow for the suction stub clearance.

TABLE 1—DIMENSIONS OF UNDERWRITERS FUEL OIL STORAGE TANKS

Actual dimensions will vary slightly with respective manufacturers

Capacity, Gallons	Diameter, Inches	Length, Feet and Inches	Shell Thickness, Inch	Head Thickness, Inch	Weight, Pounds
550	48	6-0	3/16	3/16	800
1,000	48	10-10	3/16	3/16	1,300
1,100	48	11-10	3/16	3/16	1,400
1,500	48	15-8	3/16	3/16	1,650
	65	9-0	3/16	3/16	1,500
2,000	65	11-10	3/16	3/16	2,050
2,500	65	14-10	3/16	3/16	2,275
3,000	65	17-8	3/16	3/16	2,940
4,000	65	23-8	3/16	3/16	3,600
5,000	72	23-8	1/4	1/4	5,800
	84	17-8	1/4	1/4	5,400
7,500	84	26-6	1/4	1/4	7,150
	96	19-8	1/4	1/4	6,400
8,500	108	18-0	1/4	5/16	7,250
10,000	96	26-6	1/4	5/16	8,540
	120	17-0	1/4	5/16	8,100
12,000	96	31-6	1/4	5/16	10,500
	120	20-8	1/4	5/16	9,500
15,000	108	31-6	5/16	5/16	13,300
	120	25-6	5/16	5/16	12,150
20,000	120	34-6	5/16	5/16	15,500
25,000	120	42-6	3/8	3/8	22,300
30,000	120	51-3	3/8	3/8	28,000

The annual fuel consumption may be approximated by (1) the calculated heat loss method, or (2) the degree day method. In the case of a conversion installation, reliable records of past heating operation or fuel consumption will usually produce the most trustworthy estimates for future consumption.

As an example, assume that an approximated annual fuel consumption shows 80,000 gal of fuel oil are required. During the month of January, approximately 16,000 gal will be consumed. The weekly consumption will, therefore, be approximately 4,000 gal. Adding 10% for stub clearance, will result in the selection of a 5,000 gal tank which, according to Table 1, is nearest to the minimum requirements.

TABLE 2—THICKNESS OF METAL FOR FUEL OIL TANKS

Tank Capacity, Gallons	Thickness, Minimum	Weight of Plate, Lb per Sq Ft
7 to 285	16 gage	2.50
286 to 560	14 gage	3.125
561 to 1,100	12 gage	4.375
1,101 to 4,000	7 gage	7.50
4,001 to 12,000	1/4 in. nominal	10.00
12,001 to 20,000	5/16 in. nominal	12.50
20,001 to 30,000	3/8 in. nominal	15.00

If the steam requirements are for processing, laundry or other similar load not of a heating nature, the preceding methods will not be useful. The following method may be used for sizing the fuel oil storage tank where the steam load is not of a heating nature and where reliable records of past plant fuel consumption are not available.

Assume a six-day operating week and a ten-hour operating day at which time the plant will operate at peak consumption. As an example, assume that the maximum hourly consumption is 50 gal. The daily fuel consumption will be 500 gal, and 3,000 gal for the six-day week. Adding 10% for stub clearance will result in a minimum tank capacity of 3,300 gal. The tank selected would probably be 4,000 gal.

While the preceding methods of sizing the storage tank will result in the minimum storage tank capacity, additional capacity must be allowed to compensate for the availability or distance to the source of supply, and the method of delivery. If the fuel oil is delivered by rail, the fuel oil storage tank should be sized to take a full tank car plus one week's fuel consumption. Tank cars range from 8,000 to 12,000 gal. In the preceding two examples, the minimum storage tank size for tank car delivery would be 17,000 gal. This could be met by the selection of two 8,500 gal tanks or one 20,000 gal tank.

Inside Storage Tanks

The National Board of Fire Underwriters states that inside tanks larger than 60 gal capacity shall be located at the lowest level in a building whether it be the cellar or basement or at the first floor level. Unenclosed inside storage tanks, Fig. 1, shall not be located closer

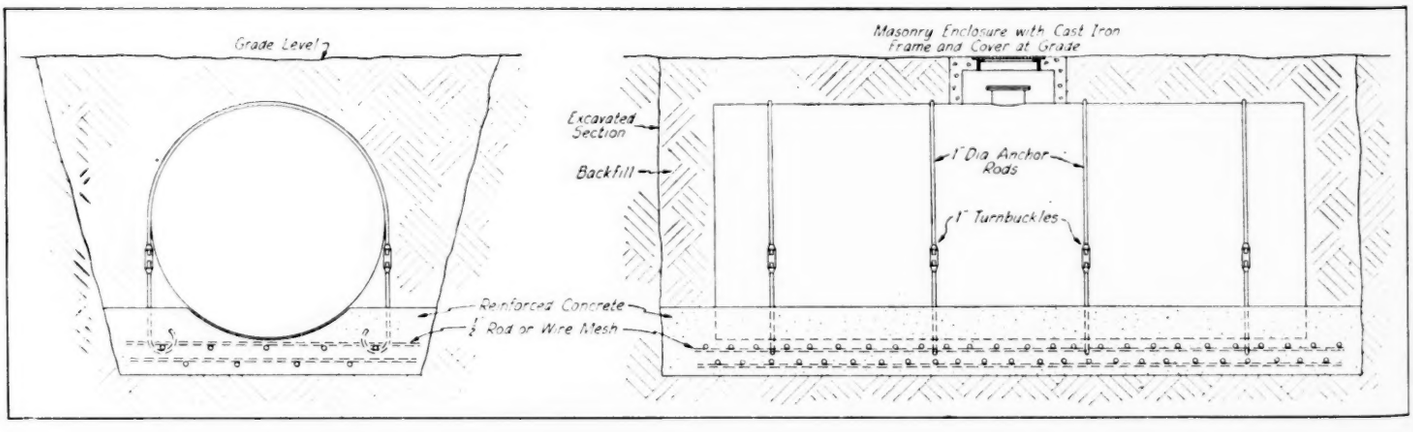


Fig. 2. Method of securing large underground storage tank when surface water condition exists.

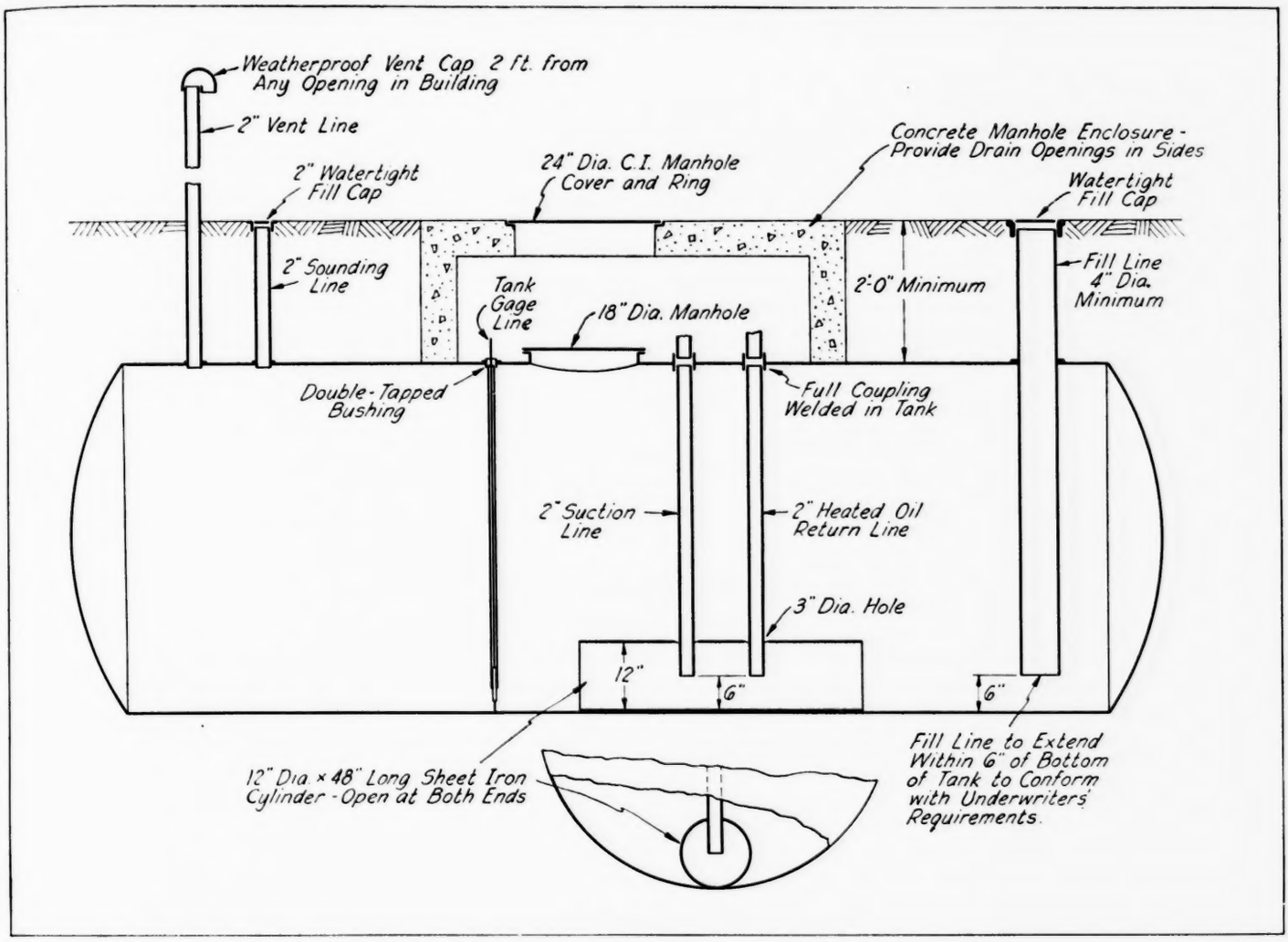

Weatherproof Vent Cap 2 ft. from Any Opening in Building
2" Vent Line
2" Watertight Fill Cap
24" Dia. C.I. Manhole Cover and Ring
Concrete Manhole Enclosure - Provide Drain Openings in Sides
Watertight Fill Cap
2" Sounding Line
Tank Gage Line
18" Dia. Manhole
2'-0" Minimum
Fill Line 4" Dia. Minimum
Double-Tapped Bushing
Full Coupling Welded in Tank
2" Suction Line
2" Heated Oil Return Line
3" Dia. Hole
12"
6"
6"
12" Dia. x 48" Long Sheet Iron Cylinder - Open at Both Ends
Fill Line to Extend Within 6" of Bottom of Tank to Conform with Underwriters' Requirements.

Fig. 3. Fuel oil storage tank with a hot well.

than 7 ft horizontally to any fire or flame. Individual oil supply tanks inside a building shall not exceed 275 gal capacity, or 550 gal aggregate capacity, unless enclosed. Enclosures shall consist of at least a 6-inch thickness of reinforced concrete, or of brick at least 8-inches thick. Between the tank and the enclosure, the space shall be filled completely with sand. If the floor above the tank is fire-resistive and has a load carrying capacity rated at least 150 lb per sq ft, the walls of the enclosure and the sand should be carried one foot above the tank; otherwise the tank must be covered with a 5-inch concrete slab or equivalent. As an alternate to this enclosure, the tank may be completely encased in 6 inches of concrete applied directly to the tank without air space.

In ordinary buildings, inside storage up to 5,000 gal is permitted. In fire-resistive buildings, up to 15,000 gal of oil may be stored inside. If special provisions are made in a fire-resistive building, up to 50,000 gal may be stored, but not more than 25,000 gal in a single tank.

Underground Storage Tanks

The National Board of Fire Underwriters recommends that oil supply tanks should preferably be located outside of buildings and underground with the top of the tank below the level of all piping to which the tank is connected, to prevent discharge of oil through a broken pipe or connection by siphoning. An underground tank shall be buried so that the top of the tank is at least two feet below grade. Otherwise the top of the tank shall be covered with not less than one foot of earth on top of which shall be placed a slab of reinforced concrete not less than 4 inches thick. The slab shall be set on a firm, well tamped earth foundation and shall extend at least one foot beyond the tank in all directions. Where tanks are buried underneath buildings, such a concrete slab shall be provided in every instance. Underground tanks should be painted with heavy asphaltum or rust-resisting paint and should be set into excavation as level as possible.

Storage tanks should never be installed in or covered with cinders. Cinders contain sulfur and when wet with water, will produce very rapid steel corrosion.

In many localities, considerable amounts of ground water may be encountered. Where such conditions are found, it is necessary to provide an anchor, Fig. 2, to secure the tank in place. The general procedure is to set the tank on a poured concrete slab, and attach the tank to this slab with steel straps or rods. The concrete slab must be reinforced with ½ inch diameter steel rods placed on centers not greater than 12-inch. The rods should be placed near the bottom of the slab where the slab is in tension. Reinforcing rods are placed crosswise in the concrete. When the concrete is poured, the anchor rods are set in place and are anchored into

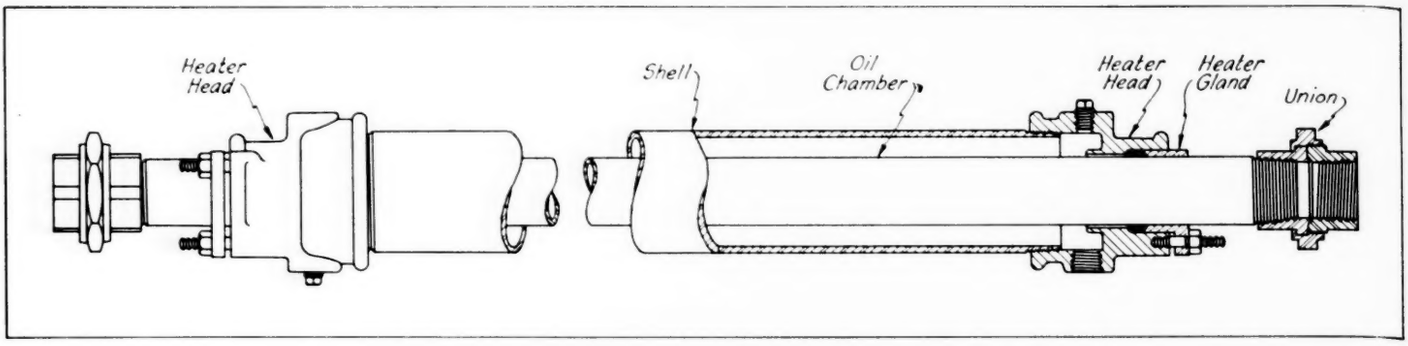


Fig. 4. Details of a manifold type return line fuel oil heater.

the slab by looping the end around horizontal rods embedded lengthwise in the concrete on either side of the tank. One-inch diameter steel anchor rods, equipped with turnbuckles for adjustment, should be placed on approximately 5 ft centers along the tank length.

The weight of the concrete necessary to secure the tank is a matter of judgment. It should be between the maximum weight necessary to sink the tank in clear water and the weight to offset the maximum amount of ground water that may be encountered in the special locality. The weight of concrete in air varies from 110 to 155 lb per cu ft, according to the material used. Commonly used averages are 150 lb per cu ft for stone concrete.

However, the actual effective weight of concrete, when immersed in water, is equal to the difference in weight between one cubic foot of concrete at 150 lb and one cubic foot of water at 62.5 lb. The effective weight of concrete is therefore 87.5 lb per cu ft. The tank is buoyed up by the weight of the displaced water. This is equal to the capacity of the tank in gallons multiplied by 8.3 lb. From this total displaced weight there may be deducted the weight of the tank, the weight of the concrete manhole enclosure, if present, the effective weight of the earth fill on top of the tank, and in the judgment of the designer any equipment that may lend its weight for this purpose. When these items have been deducted, the resulting net weight of displaced water divided by 87.5 will give the cubic feet of concrete necessary.

When the concrete is placed over the tank, the full weight of 150 lb per cu ft may be used in calculating the volume of concrete necessary. The top of the concrete would be in tension and the reinforcing rods should, therefore, be located near the upper surface of the slab. The concrete slab should extend a minimum of one foot on all sides of the tank. The slab should, therefore, be at least two feet greater in length and two feet greater in width than the tank. Also, concrete slabs may be used to prevent settling.

Practically all underground storage tanks of 3,000 gal and greater capacity are equipped with access manholes for inspection, cleaning, and repair. Standard manholes are 16 inches in diameter and are made up of a manhole flange welded to the tank, and a steel cover plate which is bolted to the tank flange. An oil-tight gasket should separate the two surfaces. When the storage tank is to be heated by a tank coil, or suction bell, a second manhole is placed near the access manhole. The piping to the coil, including the oil suction and return stubs, are welded to the steel cover plate, and the entire unit is installed as one.

To provide access to a buried tank, it is customary to install a masonry or poured concrete enclosure around the manholes and to extend this enclosure to the grade level for receiving a heavy cast iron frame and cover. The inside dimensions of the masonry enclosure should be approximately 3 ft wide and 6 ft long. The cast iron manhole at the grade level should be placed directly over the tank manhole containing the heating coil so that this entire unit may be installed and removed easily.

Above-Ground Storage Tanks

In many localities, conditions are encountered making it very costly and difficult to excavate for burying the storage tank. It is, therefore, natural that an above-ground tank installation will be considered. In general, the use of outside above-ground tanks for oil burner work should be discouraged. This type of oil storage is subject to the sudden changes of climate and the extreme cold of winter. Residual oils, when stored above-ground, will be subject to numerous temperature changes making the flow and control of such oils a very difficult problem.

Where inside storage tank space is not available, and outside conditions are such that an above-ground tank is the last resort, then the grade of fuel oil to be burned should be limited to the distillate oils which are not too greatly affected by climatic changes. However, before such an installation is made, it is best to consult with the local authorities having jurisdiction and with the Fire Underwriters' representative.

Storage Tank Heating Arrangements

Fuel tanks that are to store Bunker "C" fuel oil, and some of the more viscous grades of No. 5 oil, must be equipped with some means by which the oil can be heated to make it possible to pump these very viscous fluids.

Several heating arrangements are used for fuel oil tank heating. Probably the least expensive method, as far as the installation cost is concerned, is the hot well, Fig. 3. This method does not provide any heating in the tank itself but employs a confining chamber into which the fuel oil suction and return stubs terminate not greater than 12 inches apart. The oil is heated at the boiler by an indirect heater, using either steam or hot water as the medium, and the oil, in excess of the burning rate, is bled back to the storage tank where

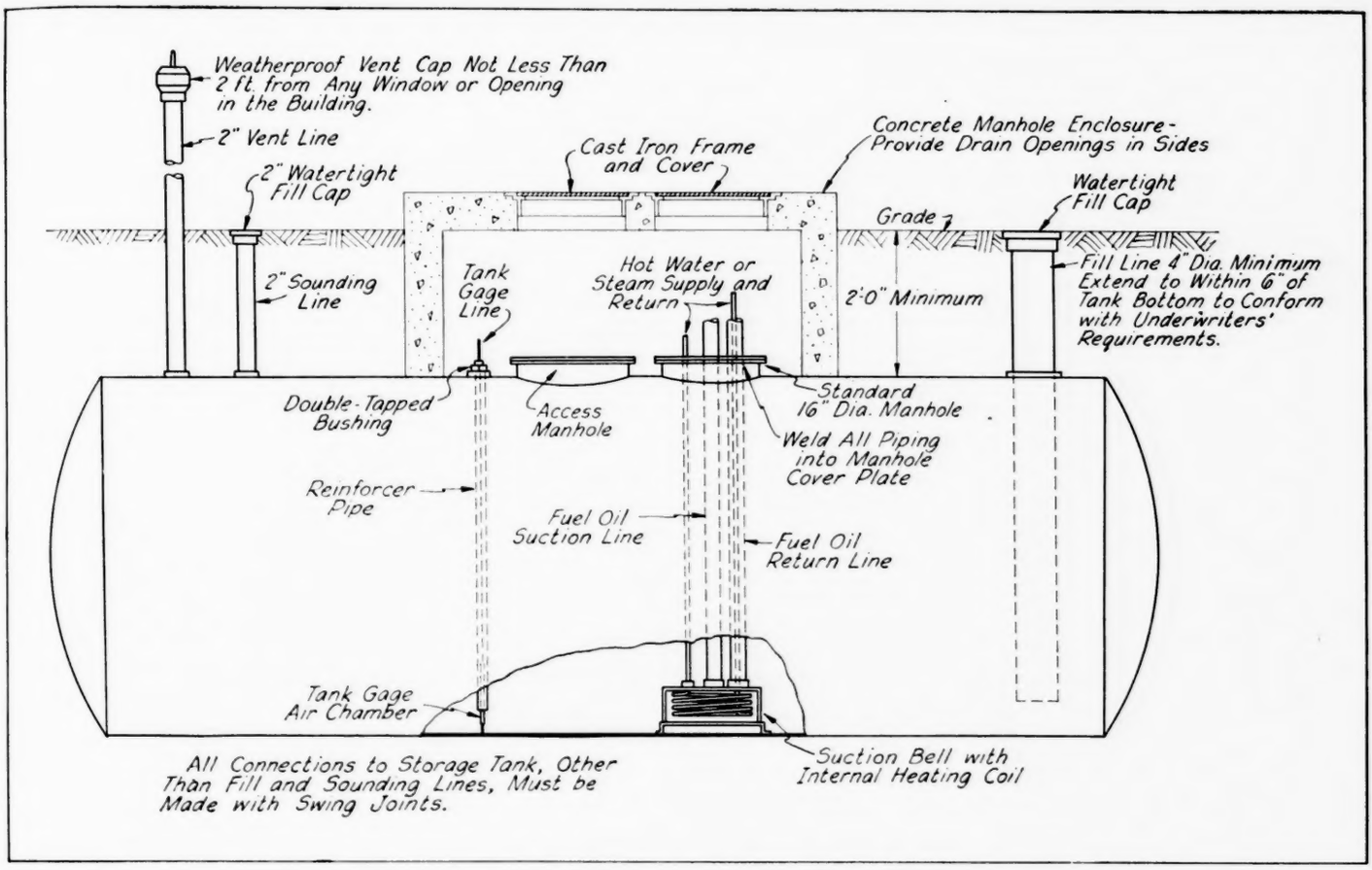

Weatherproof Vent Cap Not Less Than 2 ft. from Any Window or Opening in the Building.
2" Vent Line
2" Watertight Fill Cap
Cast Iron Frame and Cover
Concrete Manhole Enclosure - Provide Drain Openings in Sides
Watertight Fill Cap
Grade
2" Sounding Line
Tank Gage Line
Hot Water or Steam Supply and Return
2'-0" Minimum
Fill Line 4" Dia. Minimum Extend to Within 6" of Tank Bottom to Conform with Underwriters' Requirements.
Double-Tapped Bushing
Access Manhole
Standard 16" Dia. Manhole
Weld All Piping into Manhole Cover Plate
Reinforcer Pipe
Fuel Oil Suction Line
Fuel Oil Return Line
Tank Gage Air Chamber
Suction Bell with Internal Heating Coil
All Connections to Storage Tank, Other Than Fill and Sounding Lines, Must be Made with Swing Joints.

Fig. 5. Details of storage tank with suction bell.

it is mixed in the hot well to give a desired pumping temperature.

In some cases, a separate indirect heater or manifold type heater, Fig. 4, is installed directly in the fuel oil return line for this purpose.

The hot well is generally constructed on the job, using sheet iron or a lightweight steel plate. While it may be of most any shape, it must have holes for entrance of the fuel oil in the sides or ends, holes on the top for suction and return stubs, and one or two small vent holes to allow any entrained air to escape. The holes where the suction and return stubs enter, Fig. 3, should be cut one pipe size larger than the actual size of the stubs themselves.

In lieu of the hot well, it is possible to purchase a suction bell. This type of unit may be obtained from several sources of manufacture and is constructed in two types. Of the two types, one consists of a cast iron shell and a cast iron heater with extended fins. The other, Fig. 5, consists of a sheet iron shell enclosing a pipe coil. This unit may be furnished without a pipe coil and may be employed as a hot well.

In general, the suction bell is furnished with the heating element. Steam is generally used as the heating medium when it is of sufficient pressure to force the condensate back to the boiler, or where a vacuum return line pump is used. Where neither high pressure steam or a vacuum return pump is available, forced circulation hot water may be employed. The boiler water may be pumped through the suction bell or an indirect heater may be attached to the boiler which in turn will heat the water pumped through the coil.

The use of the indirect heater lessens the possibility of oil entering the boiler should a leak occur. In any event, the capacity of the suction bell heating coil is not generally sufficient in itself and it is necessary to bleed back through the main fuel oil preheater or to employ a manifold return line heater as used with the hot well.

A second and much preferred method of storage tank heating is the use of the tank coil. This method, too, consists of two general types: (1) the horizontal grid coil, and (2) the vertical helical coil. The horizontal grid coil consists of a series of heating pipes running the length of the storage tank and covering the greater part of the tank bottom. This type of coil is generally made up of 1¼- or 1½-inch steel pipe, supported approximately 12 to 18 inches above the tank bottom, and extending the full width of the tank at this point. The horizontal grid coil is best suited where it is desired that the entire tank is to be heated.

The vertical helical coil, Fig. 6, is generally constructed of 1- or 1¼-inch seamless steel tubing. Coils are generally fabricated with an outside diameter of 15 inches so that they may be inserted or removed through a standard 16-inch diameter manhole. Coils should be spaced on approximately 2-inch centers for 1-inch tube construction and 2½-inch centers when 1¼-inch tubing is used. The overall length of the coil itself should be a minimum of one-third the diameter of the storage tank. The coil should be set approximately 6 inches above the bottom of the storage tank and the fuel oil suction and return stubs carried down through the center of the coil.

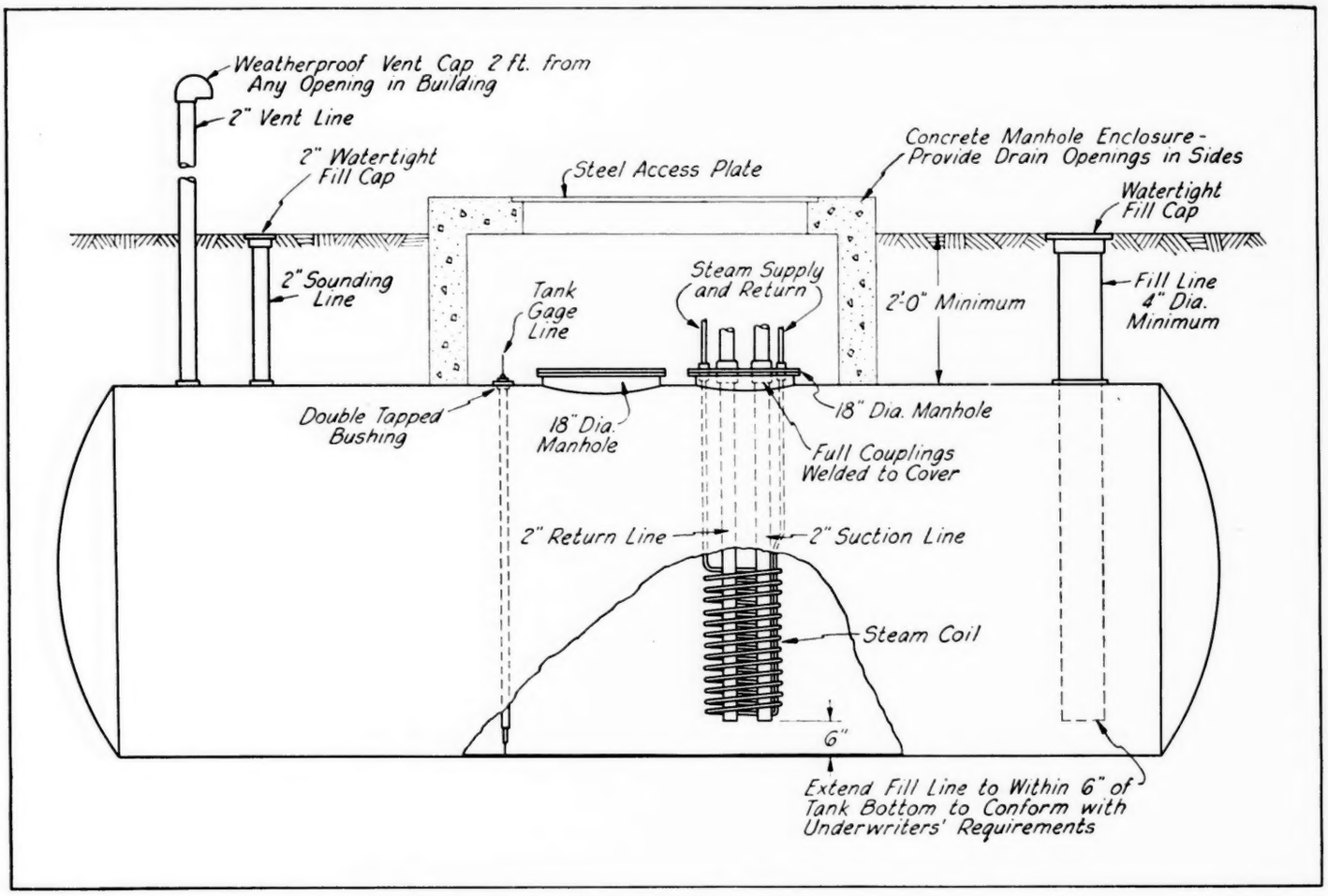

Weatherproof Vent Cap 2 ft. from Any Opening in Building
2" Vent Line
2" Watertight Fill Cap
Steel Access Plate
Concrete Manhole Enclosure - Provide Drain Openings in Sides
Watertight Fill Cap
2" Sounding Line
Tank Gage Line
Steam Supply and Return
2'-0" Minimum
Fill Line 4" Dia. Minimum
Double Tapped Bushing
18" Dia. Manhole
18" Dia. Manhole
Full Couplings Welded to Cover
2" Return Line
2" Suction Line
Steam Coil
6"
Extend Fill Line to Within 6" of Tank Bottom to Conform with Underwriters' Requirements

Fig. 6. Fuel oil storage tank with vertical helical heating coil.

The vertical helical coil, which is not intended for heating the entire tank, is used to heat the oil around the suction and return stubs for pumping only. The vertical helical coil has the advantage over the horizontal grid coil in that it may be installed and removed or replaced very easily through the tank manhole provided for this purpose. Steam or forced circulation hot water is used as the heating medium. There are several pipe fabricators that will make up a coil of this kind to suit any size or condition. There is at least one standard size coil available that can be used in most jobs.

With the various described types of heating devices in storage tanks, using steam or hot water for heating purposes, protection should be given where the pipe is buried underground. In such cases, the suction and return and the steam or hot water supply and return are all wrapped together and insulated with a waterproof covering.

Electricity is another means that has been used with success to heat the oil between the oil pump and the storage tank. In this system the suction and return oil piping actually form a low voltage circuit to heat the oil. The oil temperature is thermostatically controlled. The entire system consists of a step-down transformer, adjustable thermostat for temperature control, special insulated pipe flanges, and a special storage tank unit incorporating the suction and return stubs. Where the system is insufficient to give the desired oil temperature rise, conventional electric preheaters are inserted in the suction or return lines to give the necessary capacity.

In some installations, a complete system of steam or hot water preheaters are installed along with this system to take over after the plant is started up, and thus reduce the electrical operating cost. On some very rare occasions, insertion type electric heating elements have been inserted directly in the storage tank itself. The operating cost of heating oil by electricity has reduced its use. In general, electricity is used for cold start-up only and is supplemented by steam or hot water heating once the plant is in operation.

Tank Gages

All fuel oil storage tank installations should be equipped with some means by which the quantity of oil contained in the tank may be determined. Tank gaging equipment, or liquid-level indicating devices are made to indicate the vertical depth of the fuel oil in tanks of all descriptions, including cylindrical, rectangular, obround, horizontal, vertical, steel, and concrete. External tubular type glass gages as used on water tanks are not allowed for fuel oil storage tanks.

The simplest type of tank gage is the calibrated stick which is inserted through the fill line or a sounding line when provided. Calibrated sticks may be fabricated of wood or metal. This method, however, is limited to outside storage tanks. The National Board states that test wells shall not be installed inside buildings, and where permitted for outside service shall be closed tight, when not in use, by a metal cover designed to prevent tampering. Also, the gaging of inside tanks

by means of measuring sticks is a pronounced hazard and should not be permitted. Tank sticks must be calibrated and marked for the particular tank in which it is to be used in order to obtain a reasonable percentage of accuracy.

There are several types of automatic gages for measuring the depth of fuel oil in storage tanks that are used with oil burner installations. Small inside domestic tank installations make use of the float type gage. Various methods of operation employ the float gages. One gage consists of a series of small floats linked together, and of sufficient length to reach close to the bottom of the tank. The top end is attached to a spring loaded indicator with indicating dial which is screwed into one of the tank tappings. When the tank is full, all of the floats are buoyed up and exert no force on the indicator. As the tank is emptied, each float becomes suspended in air which in turn exerts its weight against the spring to move the indicating dial. There are other arrangements of the float gage consisting of lever arms, gearing, and other parts.

The disadvantage of the float gage is that the float becomes coated with sludge and tar and loses some of its buoyancy. At best the float gage is not accurate or dependable but merely offers a means of judging when the tank supply is low enough to require an oil delivery. The gage indicator is marked to show when the tank is full, ¾, ½, ¼, and empty. Float gages should be limited to inside domestic installations.

Distant-reading gages are employed to determine the tank contents regardless of the tank shape or location. The gage indicator may be placed at any desired point regardless of the storage tank location, up to ¼ mile distance.

The hydrostatic gage is the most common type of remote-reading liquid-level indicating device that is used with oil burner installations. In general, the hydrostatic gage consists of an air chamber which rests on the bottom of the storage tank, a small copper tube that is attached to the air chamber and is extended to a desired point within the building, and an indicating instrument attached to the end of the tubing. The hydrostatic head of the liquid in the tank exerts pressure on the air trapped in the air chamber which is in turn transmitted by the copper tubing to the indicating device. Usually there is a small pump located at the indicating instrument to replenish the air in the system that is sometimes expelled by small leaks in the tubing and connections. Hydrostatic gages are sufficiently accurate for use with distances up to ¼ mile from the tank to indicator. When selecting a hydrostatic gage it is necessary to know the depth or diameter of the storage tank, the specific gravity of the oil, and the length of the communicating tubing.

Hydrostatic gage indicators are of several different types: Those with red indicator fluid in a glass tube, those using mercury liquid in a glass tube, and those using a dial indicator. In the first two of these types of indicators, the liquid in the gage glass is supported at the proper level by the direct action of the air pressure corresponding to the hydrostatic head of oil in the tank. The third type is by action of the air pressure on a bellows that is converted into pointed indication through knife-edge bearings.

Another type of remote-gage is the float hydraulic gage, a completely self-contained unit that can be tested for proper operation before it is installed. This system consists of a tank unit made up of a large copper float which is supported in the tank by a lever arm mechanism. This, in turn, is attached to and operates a system of bellows. Another system of bellows is contained in the indicating device placed within the building. The two units are connected together by tubing filled with a liquid. As the depth of liquid in the tank changes, the float moves and thus operates the bellows at the tank unit. This motion is transmitted by the liquid in the tubing and thus positions the bellows at the indicating device which in turn operates the indicating pointer. When selecting this type of gage, the inside diameter of the tank and the length of the transmitting tubing must be known.

Tank gages should be installed as close to the center of the tank as possible to minimize the effect of uneven installation or uneven settling of the storage tank. A reinforcer pipe, one inch or larger, with a double tapped bushing, should be used with each hydrostatic gage tank assembly to insure that the brass air chamber is resting on the tank bottom. The reinforcer pipe should extend down to approximately 4 inches from the tank bottom. The transmitting tubing or conduit should be run in a protective pipe which should extend from the storage tank, underground, and through the building foundation. Protective piping diameters will range from 1 to 2 inches, depending upon the type of gage used.

Hydrostatic and mechanical gages offer a reasonably accurate means of determining a tank's contents. When properly installed they will give an accuracy within 1%. However, there are conditions beyond the accuracy of the gage that will result in very erroneous readings.

Fuel oil storage tanks assume a slight change when full from that when they are empty. The sides and ends of rectangular tanks buckle outward, thus increasing the tanks actual capacity. While this is also true for the ends of horizontal cylindrical tanks, the change in capacity is less affected. Errors up to 3 or 4% can result from this condition. Underground tanks are generally not set level to start with, and, in addition, one end of the tank will probably settle more than the other after the installation is made. In addition, a tolerance of 10% in capacity for tanks over 1,100 gallons is allowed at the time of fabrication. It is, therefore, evident that absolute accuracy in tank measurement is not to be expected.

Another type of indicating device that has been used successfully is installed completely independent of the storage tank. The instrument is actuated by the plus or minus pressure of a column of oil on a large metallic bellows, the movement of which is transmitted to an indicator needle. Oil level in the tank is indicated in feet on a large dial. Installation cost of this type of gage is practically nothing. A tee is inserted in the fuel suction line and the gage is screwed into it. No other connections are necessary. Before selecting this type of gage, one should know the specific gravity of the fuel oil, the depth of the storage tank, and vertical distance that the gage will be located above or below the storage tank.

Insolation on Clear Days

at the Time of Solstices and Equinoxes for Latitude 42° N.

Charts are published to show the daily hourly values for insolation on various surfaces at the time of the solstices and equinoxes. Other solar energy data and information regarding instrumentation are given.

I. F. HAND
U. S. Weather Bureau, Blue Hill Observatory, Milton, Mass.

THE total energy received by the earth from the sun varies with the period of the year and the sun angle, and is dependent on the latitude in which the observations are made.

A graphic presentation of the diurnal march of insolation received for several surfaces at the time of the solstices, June 21 and December 21, and the equinoxes, March 21 and September 21, at latitude 42° North on cloudless days, is given in Figs. 1, 2, and 3. While these values may be representative of that part of the United States at approximately 42° N. latitude, any attempt to estimate the amount of solar energy received on similar surfaces in other areas of similar latitude must include consideration of elevation and atmospheric conditions. For example, Boston is only 10 miles north of the station where these published values were obtained, but the average annual receipt of solar energy is 15% less in this industrial city than at Blue Hill Observatory.

In Table 1, days with slightly more than average intensities were selected in order to eliminate the effect of slight cloudiness. No traces were prepared for partly cloudy skies, for they would be meaningless owing to the enormous variation in solar energy received. While traces might be prepared for overcast skies, they also would show so much variation that they would be of little value.

Although the amount of precipitable water in the atmosphere is greater in mid-June than in autumn or winter, the maximum radiation on a horizontal surface at noon is highest at the time of the summer solstice owing to the more favorable angle of the rays. The noon normal-incidence values are about the same in September and December, as the greater path through which the rays pass in winter as compared with autumn is compensated for by decreased water-vapor content of the atmosphere in winter.

In order to obtain observational data for use in studies of utilization of solar energy for house heating or air conditioning, 180° pyrheliometers have been mounted vertically facing south, east, and north. The east-vertical traces rise sharply immediately follow-

TABLE 1—REPRESENTATIVE VALUES OF INSOLATION, BTU PER (SQ FT) (MIN), ON CLOUDLESS DAYS AT BLUE HILL OBSERVATORY, LATITUDE 42°13'N.

Hour Angles															Surface on Which Energy is Received
*7:32	7:00	6:30	6:00	5:30	5:00	4:30	4:00	3:30	3:00	2:30	2:00	1:30	1:00	0:30	0:00	
June 21																
0	1.81		3.10		3.76		4.17		4.46		4.65		4.76		4.80	Normal incidence
0		0.74		1.73		2.77		3.62		4.35		4.91		5.17	5.24	Horizontal surface
0		0.26		0.44		0.52		0.74		1.37		1.84		2.03	2.07	Vertical facing south
0		1.18		1.03		0.63		0.37		0.41		0.42		0.44	0.44	Vertical facing north
0		2.32		3.25		3.76		3.58		2.95		2.03		0.92	0.81	Vertical facing east, a.m.
0		0.18		0.30		0.44		0.55		0.63		0.66		0.74		Vertical facing east, p.m.
0		0.18		0.37		0.52		0.66		0.77		0.85		0.89	0.89	Diffuse
March 21 and September 21																
			0		3.06		3.91		4.35		4.54		4.65		4.69	Normal incidence
			0	0.44		1.59		2.69		3.58		4.17		4.54	4.56	Horizontal surface
			0	0.37		1.40		2.32		3.25		3.95		4.32	4.35	Vertical facing south
			0	0.11		0.26		0.37		0.44		0.50		0.55	0.55	Vertical facing north
			0	1.22		3.06		3.99		3.62		2.69		0.85	0.63	Vertical facing east, a.m.
			0	0.11		0.30		0.41		0.48		0.55		0.59		Vertical facing east, p.m.
			0	0.15		0.33		0.48		0.63		0.72		0.79	0.81	Diffuse
December 21																
						0†	2.55		3.84		4.32		4.58		4.65	Normal incidence
						0		0.66		1.48		2.10		2.40	2.47	Horizontal surface
						0		2.29		3.76		4.61		5.11	5.17	Vertical facing south
						0		0.22		0.41		0.55		0.61	0.65	Vertical facing north
						0		2.88		3.14		2.29		1.29	0.92	Vertical facing east, a.m.
						0		0.26		0.44		0.59		0.70		Vertical facing east, p.m.
						0		0.28		0.48		0.61		0.68	0.72	Diffuse

*Sunrise and sunset.
†Sunrise and sunset occur at the hour angle of 4:28.

TABLE 2—COMPARISON OF CLOUDLESS DAY RADIATION DATA
Energy per Minute at Noon

Date	Normal Incidence, Average Btu per (Sq Ft) (Min) (1)	Sine a (2)	Normal Incidence Energy Times Sine a (1) (2) (3)	Diffuse on a Horizontal Surface. Average Btu per (Sq Ft) (Min) (4)	Calculated Horizontal Solar Energy Plus Diffuse Energy (3) + (4) (5)	Measured Total Solar and Sky Radiation on a Horizontal Surface. Average Btu per (Sq Ft) (Min) (6)	Calculated Total Energy on Horizontal Surface Minus Measured. Btu per (Sq Ft) (Min) (7)
June 21	4.80	0.946	4.54	0.89	5.43	5.24	0.19
March 21 and Sept. 21	4.69	0.742	3.48	0.79	4.27	4.58	—0.29
Dec. 21	4.65	0.409	1.90	0.68	2.58	2.47	0.11
1947 Selected Dates							
June 22	5.02	0.940	4.72	0.52	5.24	5.24	0.00
Sept. 22	5.09	0.739	3.76	0.30	4.06	4.17	—0.11
Dec. 21	4.72	0.415	1.96	0.37	2.33	2.29	0.04

ing sunrise for, at that time of day the solar rays are more nearly normal to the receiving surface of the pyrheliometer than at any other time of day. No traces for a vertical surface facing west have been drawn, but aside from slight irregularities, owing to unequal distribution of morning and afternoon water vapor content of the atmosphere, they should resemble the east-vertical traces in reverse.

Between March 21 and September 21, the sun rises north of east and sets north of west at latitude 42° N. Therefore, there is a sharp rise of radiation on the north-vertical surface immediately following sunrise and preceding sunset on the drawing for June 21, Fig. 1. As soon as the sun reaches a point south of east, the trace flattens out, for then and until the sun is due west, diffuse radiation only is recorded (see trace in Fig. 1) from the pyrheliometer facing north.

The traces representing the equinoxes are averages of the March and September data. Actually, there is slightly more insolation during mid-September than during mid-March owing to the relative clearness of the atmosphere in autumn.

The formula for converting values of solar energy received on a surface normal to the sun to the amount received on a horizontal surface is

$$I_h = I_n \sin a + D$$

where for any moment, I_h is the solar and sky energy received on a horizontal surface, I_n the solar energy received on a surface normal to the sun, a is the solar altitude, and D is the diffuse sky radiation. Therefore, if we convert normal incidence values to those received on a horizontal surface and add the values of diffuse radiation, theoretically we should obtain values equal to the total solar and sky energy received on a horizontal surface. Practically, however, this procedure seldom proves strictly accurate owing to errors of various kinds, chiefly those of the pyrheliometers and recorders.

Values in the first part of Table 2 were taken directly from Table 1 and are the means of all cloudless days within plus or minus one week of the times of solstices and equinoxes, respectively, since the beginning of the measurements of diffuse radiation in October, 1945. As there are comparatively few absolutely cloudless days at Blue Hill, not more than five days were used for making up any mean. The values in

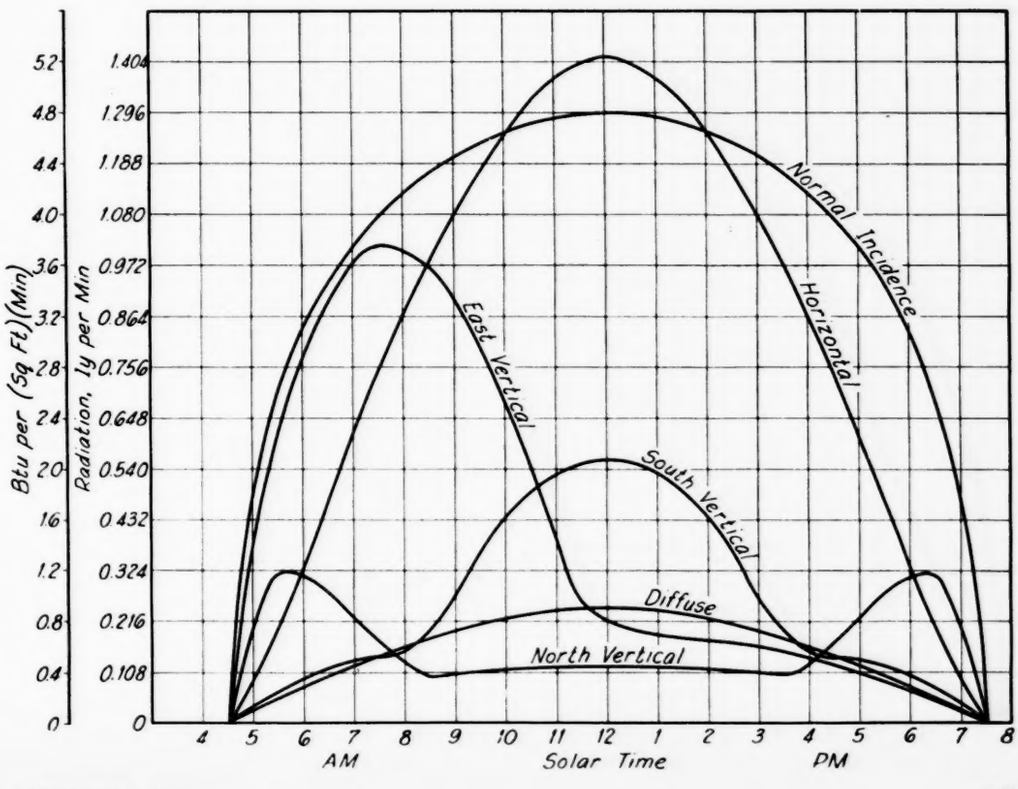


Fig. 1. Insolation on cloudless days, June 21, for latitude 42° N.

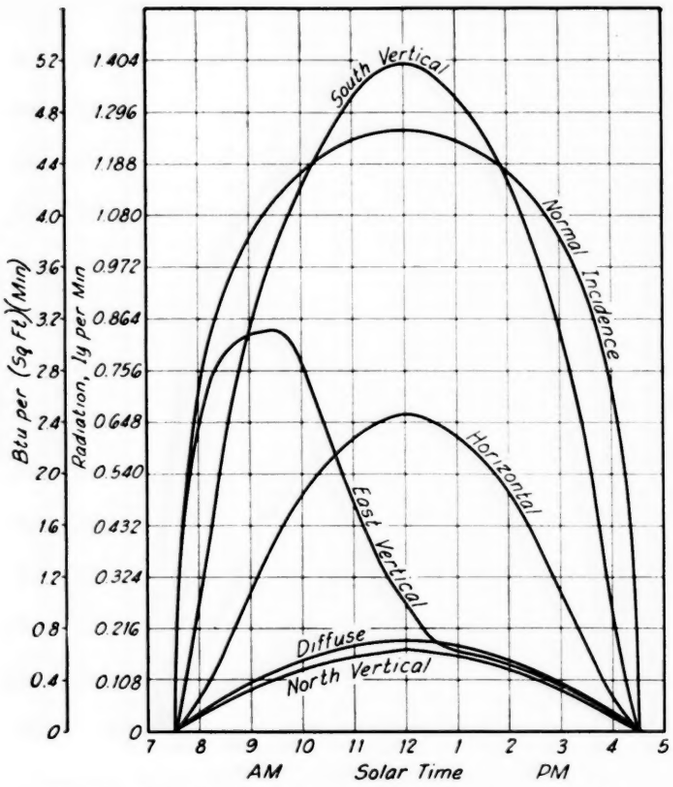


Fig. 2. Insolation on cloudless days, December 21, for latitude 42° N.

column 6 of Table 2 are for the clearest individual days occurring close to the equinoxes and solstices since October, 1945.

Column 1 lists the solar energy received on a surface normal to the sun at solar noon for the respective days. Column 2 represents the sine of the solar altitude at the times specified. Column 3 gives the product of the values in columns 1 and 2, or the amount of solar energy which would be received on a horizontal surface from the sun alone. Column 4 lists the diffuse energy, which, added to the values in column 3, gives the values in column 5, or the amount of solar energy which would be received from the sun and sky on a horizontal surface. But we made actual measurements, at the middle of the hour preceding solar noon, of the total solar and sky energy received on a horizontal surface as recorded in column 6. Column 7 shows the departure of the calculated from the measured values.

Eppley 180° thermoelectric pyrheliometers and recording potentiometers were used to obtain all the data with the exception of the normal incidence values. An Eppley normal incidence pyrheliometer on an equatorial mounting and a recording potentiometer were used to measure the direct radiation received on a surface normal to the sun's rays. While the pyrheliometer which was mounted horizontally received all direct energy from the sun, and the diffuse energy from the entire sky, pyrheliometers mounted vertically facing the cardinal points received energy from only one-half the sky. However, these instruments received reflected energy from the earth, which, with a snow-cover in mid-winter, is an appreciable amount. Diffuse energy from the sky was obtained through the use of an occulting ring which continuously shaded the receiving surface of the pyrheliometer from the sun, but let nearly all sky energy strike the receiving surface.

Accuracy of the Instruments

Solar energy received at the earth's surface ranges in wave-length from about 0.3μ to several microns. The Eppley 180° pyrheliometer is sensitive to all wavelengths between 0.3μ and 2.5μ, or more than 99% of the energy which impinges upon the outer surface of the hemispherical glass cover. Special alloys of gold-palladium and platinum-rhodium tend to minimize errors arising from fluctuations in temperature. Errors will develop from temperature fluctuations and imperfect energy transmission. Errors in the daily totals of radiation may be as much as 5% with this instrument.

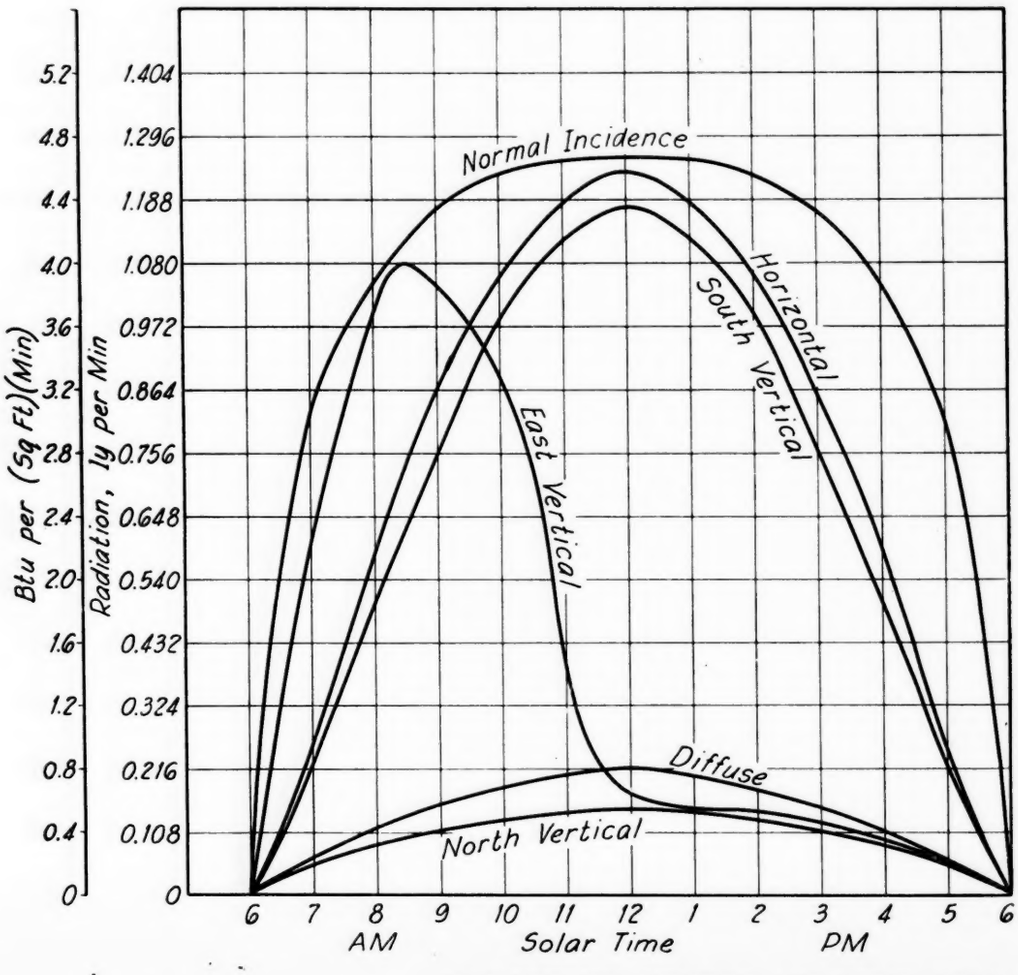


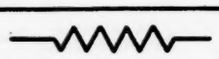
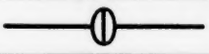
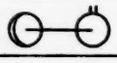
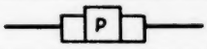
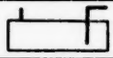
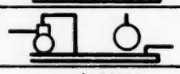
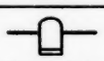
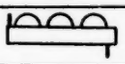
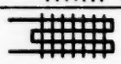
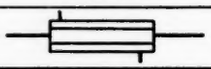
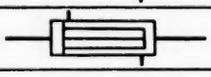
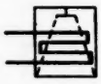
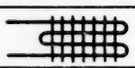
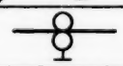
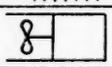
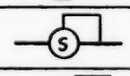
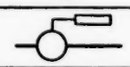
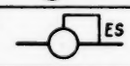
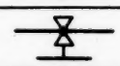
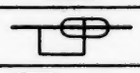
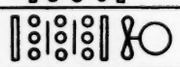
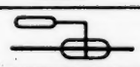
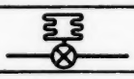
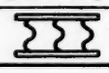
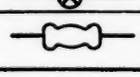
Fig. 3. Insolation on cloudless days, March 21 and September 21, latitude 42° N.

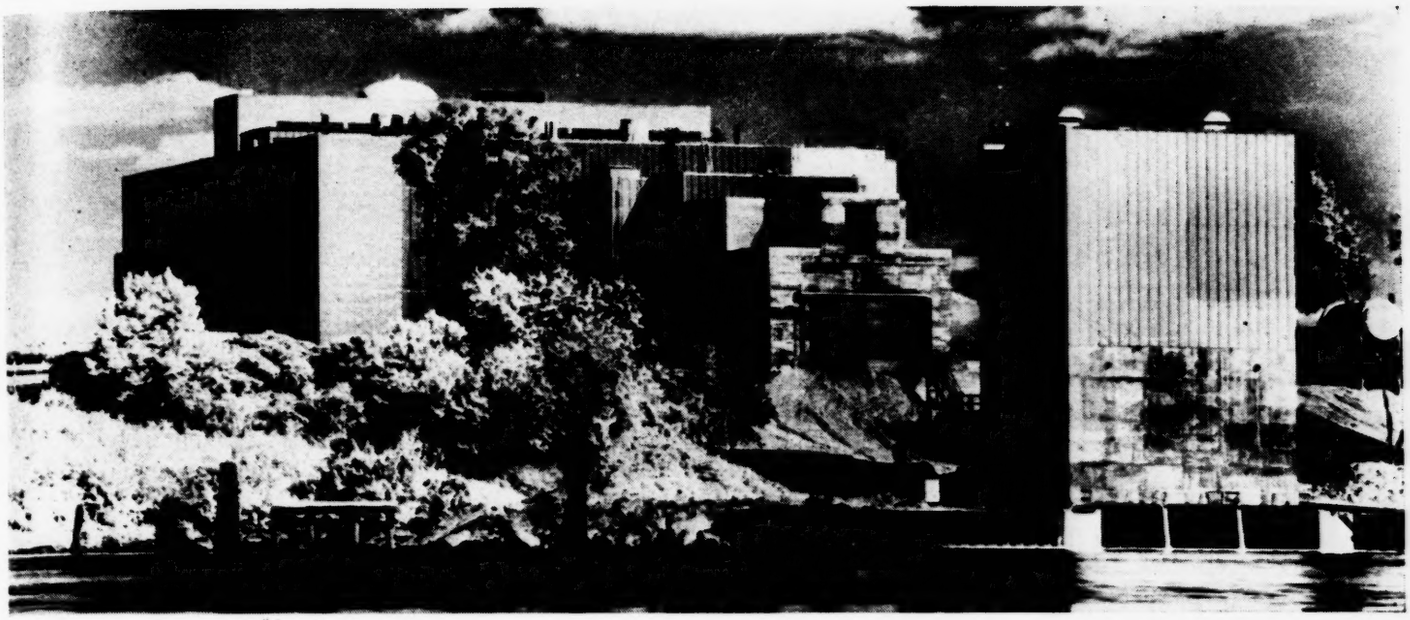
AMERICAN STANDARD GRAPHICAL SYMBOLS – HEATING AND VENTILATING

The accompanying symbols were designated as an American Standard in May, 1949, by the American Standards Association, sponsoring organizations being The American Society of Mechanical Engineers and American Institute of Electrical Engineers.

AIR ELIMINATOR	ACCESS DOOR (AD)
ANCHOR (PA)	ADJUSTABLE BLANK OFF (TR 20×12)
EXPANSION JOINT	ADJUSTABLE PLAQUE (P-20×12-700cfm; P-20"ø-700 cfm)
HANGER OR SUPPORT (H)	
HEAT EXCHANGER	AUTOMATIC DAMPER (M)
HEAT TRANSFER SURFACE (Plan-Indicate type, such as convector)	
PUMP (Indicate type, such as vacuum) (M)	CANVAS CONNECTION
STRAINER	DEFLECTING DAMPER
TANK (Designate type) (REG)	
THERMOMETER	DIRECTION OF FLOW
THERMOSTAT (T)	DUCT (First figure is side shown) (12×20)
TRAP, BOILER RETURN	DUCT SECTION (Exhaust or return) (E or R 20×12)
TRAP, BLAST THERMOSTATIC	DUCT SECTION (SUPPLY) (S 20×12)
TRAP, FLOAT (F)	EXHAUST INLET, CEILING (Indicate type) (CR 20×12 - 700 cfm; CG 20×12 - 700 cfm)
TRAP, FLOAT AND THERMOSTATIC	EXHAUST INLET, WALL (Indicate type) (TR - 12×8 700 cfm)
TRAP, THERMOSTATIC	
UNIT HEATER (Centrifugal fan type - Plan)	FAN AND MOTOR (With belt guard)
UNIT HEATER (Propeller fan type - Plan)	
UNIT VENTILATOR, PLAN	INCLINED DROP (In respect to air flow) (D)
VALVE, CHECK	INCLINED RISE (In respect to air flow) (R)
VALVE, DIAPHRAGM	INTAKE LOUVERS
VALVE, GATE	
VALVE, GLOBE	LOUVER OPENING (L 20×12 - 700 cfm)
VALVE, LOCK AND SHIELD	SUPPLY OUTLET, CEILING (Indicate type) (20" DIAM. 1000 cfm)
VALVE, MOTOR-OPERATED (M)	SUPPLY OUTLET, WALL (Indicate type) (TR - 12×8 700 cfm)
VALVE, PRESSURE-REDUCING	VANES
VALVE, RELIEF (Either pressure or vacuum) (R)	
VENT POINT (VENT)	VOLUME DAMPER

AMERICAN STANDARD GRAPHICAL SYMBOLS – AIR CONDITIONING

CAPILLARY TUBE 	FILTER, LINE 
COMPRESSOR	FILTER AND STRAINER, LINE
COMPRESSOR, ROTARY (Enclosed crankcase, belted)	FLOAT, HIGH SIDE
COMPRESSOR, RECIPROCATING (Open crankcase, belted)	FLOAT, LOW SIDE
COMPRESSOR, RECIPROCATING (Open crankcase, direct-drive)	GAGE
MOTOR-COMPRESSOR, RECIPROCATING (Direct-connected, enclosed crankcase)	PRESSURESTAT
MOTOR-COMPRESSOR, ROTARY (Direct-connected, enclosed crankcase) 	PRESSURE SWITCH
MOTOR-COMPRESSOR, RECIPROCATING (Sealed crankcase)	PRESSURE SWITCH (With high pressure cut-out) 
MOTOR-COMPRESSOR, ROTARY (Sealed crankcase)	RECEIVER, HORIZONTAL 
CONDENSING UNIT (Air cooled)	RECEIVER, VERTICAL
CONDENSING UNIT (Water-cooled) 	SCALE TRAP 
CONDENSER, AIR COOLED (Finned, Forced Air)	SPRAY POND 
CONDENSER, AIR COOLED (Finned, static) 	THERMAL BULB
CONDENSER, WATER COOLED (Concentric tube in a tube) 	THERMOSTAT (Remote bulb)
CONDENSER, WATER COOLED (Shell and coil)	VALVE, EXPANSION, AUTOMATIC
CONDENSER, WATER COOLED (Shell and tube) 	VALVE, EXPANSION, HAND
CONDENSER, EVAPORATIVE 	VALVE, EXPANSION, THERMOSTATIC
	VALVE, COMPRESSOR SUCTION PRESSURE LIMITING (Throttling type, compressor side)
COOLING UNIT, FINNED (Natural convection) 	VALVE, CONSTANT PRESSURE, SUCTION 
COOLING UNIT (Forced convection) 	VALVE, EVAPORATOR PRESSURE REGULATING (Snap action) 
COOLING UNIT, IMMERSION	VALVE, EVAPORATOR PRESSURE REGULATING (Thermostatic throttling type) 
COOLING TOWER	VALVE, EVAPORATOR PRESSURE REGULATING (Throttling type, evaporator side) 
DRYER	VALVE, MAGNETIC STOP
EVAPORATOR, CIRCULAR (Ceiling type, finned)	VALVE, SNAP ACTION 
EVAPORATOR, MANIFOLDED (Bare tube, gravity air)	VALVE, SUCTION VAPOR REGULATING 
EVAPORATOR, MANIFOLDED (Finned, forced air) 	VALVE, SUCTION 
EVAPORATOR, MANIFOLDED (Finned, gravity air)	VALVE, WATER 
EVAPORATOR, PLATE COILS (Headered or manifolded) 	VIBRATION ABSORBER, LINE 



Jet Laboratory Nears Completion

A NEW $12 million laboratory, designed and built expressly for test of experimental jet engines, will be named the Andrew Willgoos Turbine Laboratory in memory of the late chief engineer of Pratt & Whitney Aircraft. Mr. Willgoos had a leading part in shaping the plans for the jet test center.

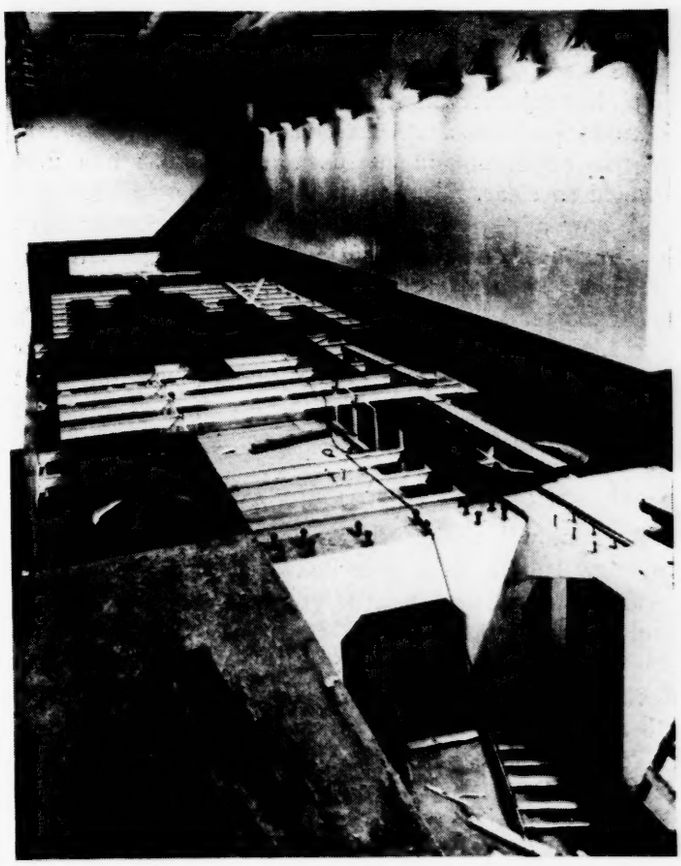
The massive concrete and steel structure, designed by Albert Kahn Associated Architects and Engineers and built by Pratt & Whitney Aircraft division of United Aircraft Corp., is complete except for the installation of a few major pieces of equipment. The Willgoos Laboratory, the finest jet laboratory to be built by an aircraft firm, will go into operation within the first three months of 1950. The windowless building, six stories high and 400 feet long, is the main unit for a jet development program in which Pratt & Whitney Aircraft has expended $15 million in laboratories since the end of World War II.

The saving of a large sum in the Willgoos Laboratory was accomplished chiefly through the purchase of the power generating equipment. Four boilers, built for navy cruisers, were on their way to a Philadelphia junkyard to be cut up for scrap after the war when the Pratt & Whitney Aircraft purchasers found them. The boilers were purchased at a small fraction of the cost of building new boilers. Six returned lend-lease destroyer escort vessels, declared war surplus, yielded similar discounts on twelve turbo-generator sets.

The new turbine laboratory, on the east bank of the Connecticut River, has four test cells in which engines or engine components will be tried. Two cells are on each end of the building, which extends east and west. The lower roof levels and reinforced concrete walls — two feet thick in places — distinguish them from the central part of the laboratory, which has double insulated walls faced with corrugated steel sheets. Of the two adjoining 135-foot-long test cells on the east end, the north chamber (already named X204) will be used to test the turbine compressors. Because of the high power needed for compressor testing, a 21,500 horsepower electric driving motor will be used in the chamber. The neighboring chamber to the south will test entire engines or their turbines.

On the west end of the laboratory are two identical

(Concluded on page 118)



Test cell 135 ft long, one of four at laboratory

Experience is my Classroom

By T. W. REYNOLDS

• SELLING TO ENGINEERS

The salesman, particularly when still new in the field, is apt to leave an engineer's office with a look of discouragement or even indignation on his face. Seldom does he realize that selling an engineering product to an engineer requires an entirely different approach than selling consumer goods to laymen. The layman is interested in gadgets, and tends to be oversold on new ideas.

The engineer, however, from training and experience is looking for what is wrong, so as to protect his client as well as his own prestige. The engineer asks critical questions and takes a negative attitude, and yet may be a most likely customer. His very questions show that he is interested. The salesman should beware of the engineer who asks no questions and who just yesses him on everything. With such a customer, the interview will quickly terminate from lack of virility, so that he may soon find himself outside the door, having had a pleasant time and no results.

Such thoughts take me back to an elaborate unveiling of a new product by a manufacturer at his laboratory in the days when a hundred engineers could be sold, fed, and entertained with no worry about expense. Environment and moderate use of the bottle made for attention, good will and an expansive mood in all but one prominent engineer who asked and raised so many embarrassing questions that other engineers became doubtful and confused about what had first seemed so clear.

It now appeared that the exhibit had better been left unshown and the despair of the management was evident. Then, after the dinner, this same engineer arose to speak. What would come next was anybody's guess. What did come next was a complete surprise —a virtual endorsement of the product based on what he had seen and had answered and had been disclosed without evasion.

• KNOWING WHERE TO FIND THE ANSWER

A client who manufactures some new gadget wants to know if you have ever had any experience in air conditioning this gadget. If you have been up late the night before you tell him that you have never air conditioned a job for Mr. Smith, but did so for Mr. Jones, and imagine the requirements are not so different as are the names.

There must be a first time for everything, but aside from this there has been years of experience in knowing how to attack new problems, in knowing specialists to turn to even as they occasionally turn to you, and otherwise having ingenuity in knowing where to look for information. One of the most famous lawyers said he didn't know the law, but he knew where to look for it.

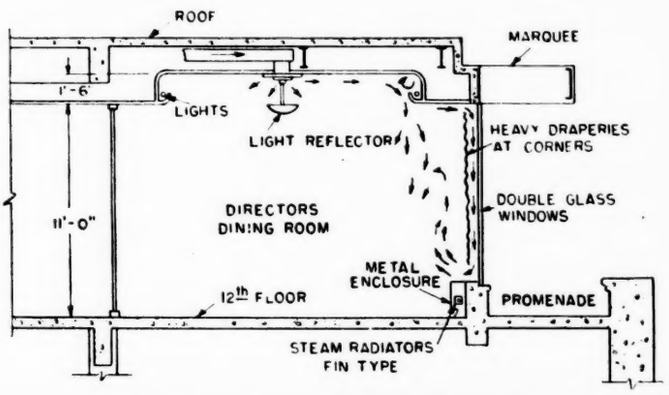
Some people tell you it is futile for you to try to learn the details of some business. They have been in it all their lives and time is no longer sufficient, at your age, to learn the business. Nonsense, all you need to know is the right experts, travel a bit to related business, observe closely and ask a lot of questions about the problem. One month or less of concentration should do it.

To the writer's knowledge there has never been but one air conditioned ball—the Perisphere at the 1939 World's Fair, yet the writer air conditioned that one. He imagines that if ever a second one must be cooled, somehow, somewhere, someone else will be found equal to the task.

• THE DARK HORSE IN TROUBLE HUNTING

For each trouble there is a certain number of possible causes as known from previous experiences, so one must go through the process of elimination, tedious though this may be to those who have gone through this before. When this has been done and the difficulty still remains, though perhaps in lesser degree, the problem from there on becomes much more interesting. The accompanying sketch shows what is in mind—a problem of draft in a private dining room for some executives. This is a room with two of its walls outside and at right angles to one another and each with a large area of double glass exposed at the worst to 30F below zero. In the corner where the two walls of glass meet, down-drafts were most noticeable.

Smoke tests showed air from a ceiling outlet deflected to some extent downward by air striking the



The dark horse in trouble hunting.

Note: Mr. Reynolds is Chief, Air Conditioning Division, Abbott, Merkt & Co., Engineers, New York.

lighting cove. Unfortunately, there had to be a considerable air volume from the outlet to take care of the large glass area, and to make matters worse there was a beam preventing extension of duct as a pressure cushion for distributing the air discharge over the face of the outlet. In addition to these things, the combination of light fixture with air outlet prevented the installation of dampers back of the outlet for equalization of air flow. Therefore the only thing that could be done was to baffle the discharge of the outlet on the sides opposite the affected corner.

While the baffle was of some help, it did not eliminate cold drafts, so that the volume of air was cut down by the damper and its temperature raised, and finally the duct was zoned from the rest of the system. As the draft still remained, the trouble was then attributed to oversized and overlong steam radiation, but briefly on and mostly off. Keeping the steam on these radiators somewhat longer made the space hot, but too hot, so that a more detailed smoke test was then made. The real cause of the difficulty was then discovered. It seems that heavy draperies, as folded back at the drafty corner, made a down flue back of them for cold air. Even when the radiators were hot, their air discharge as a hot air column upward seemed but to serve as more rapid drop of the cold air column in the down flue along the glass.

• DUST FROM PACKING MATERIALS

The unpacking of chinaware in a store warehouse sets up a very fine dust which generally settles on unpacked china and shelves of storage bins whether near or distant from the receiving area. The dust is a nuisance and particularly on china which must be wiped clean. This additional handling entails a certain amount of breakage.

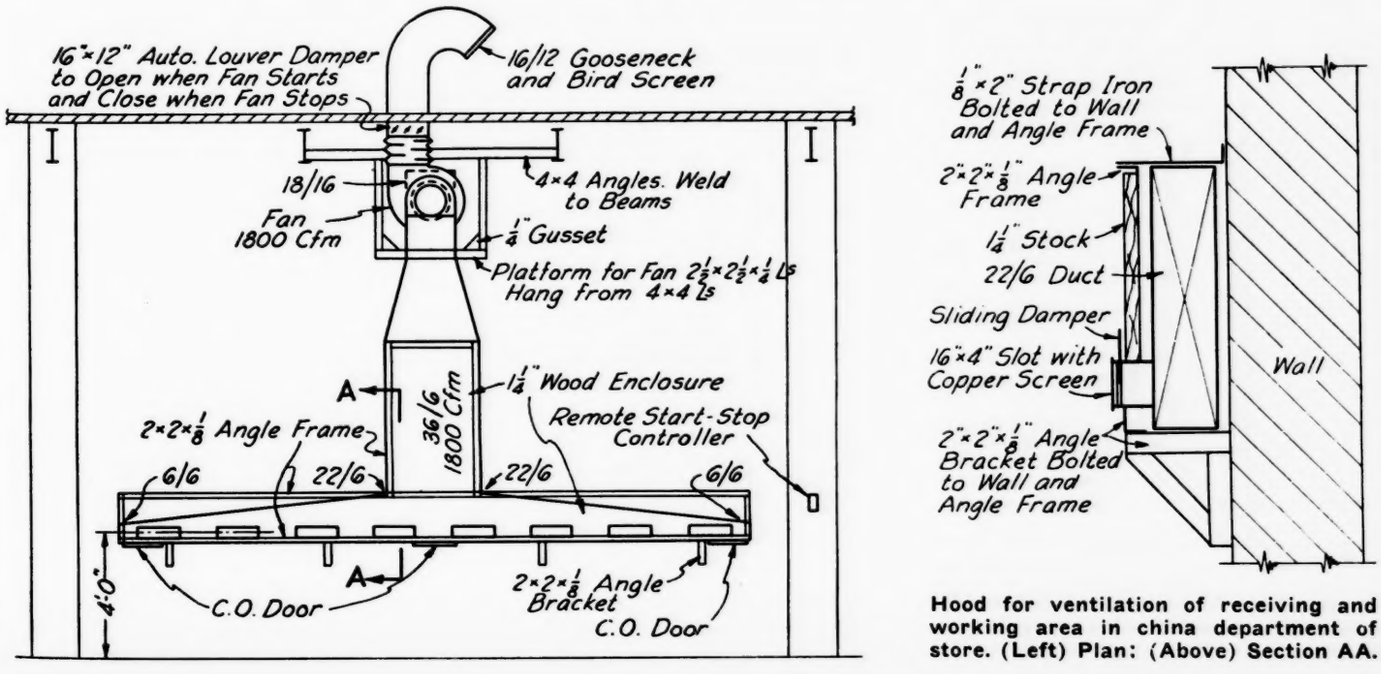
China, as received, comes in huge packages or bales. The bales are of straw or excelsior—if from abroad—or salt hay, excelsior, or various grades of shredded paper—if domestic. Some of these packing materials absorb less moisture than others and dry out quicker, though very moist when first packed. Straw moistened for better packing has very little moisture left by the time it is transported, stored, and finally unpacked. Foreign shipments should therefore be unpacked as received. An additional reason is the decreased fire hazard through the immediate removal of such highly combustible materials.

During the war some shipments of china in straw from abroad laid around for two years. When the bales were eventually moved and turned over for unpacking all of the china crashed. It seems that the interior of the bales had collapsed to dust leaving practically nothing to take up the shock.

Straw makes the most dust, though shredded paper of a fine grade can be very dusty. Excelsior, on the other hand, seems to hold the moisture better. It, therefore, makes less dust, particularly so when received from abroad, for it is a heavier grade and is packed wet.

The dust that doesn't settle on china and bins is drawn into one's lungs. Those who are susceptible find this a bit annoying, though seldom to the point where a protective mask will be worn for long or used at all. Masks are cheap, filtering refills even cheaper. Refills of cotton, single or double, are held in place by aluminum clips easily bent to the contour of the face, the whole secured to the head by elastic straps.

The accompanying sketch illustrates a good method of removing the dust immediately as formed in a packing space which is 24 ft x 6 ft x 6 ft high. Air changes are 125 per hour, but may be lessened by suitable control. Inlets to duct have a velocity of 500 fpm, but when dampers are closed half way the velocity is doubled, as may be desired at times for better dust removal. Closing some of the dampers will allow even higher velocities. Velocity limitations include the clogging of inlet screens with shredded paper or other light materials, and also the liability to drafts in low temperature warehouses. Drafts are more likely with no pre-heat of make-up, especially in small warehouses or where the packing area is too close to doors or windows on the windward side



⅛"×2" Strap Iron Bolted to Wall and Angle Frame
2"×2"×⅛" Angle Frame
1¼" Stock
22/6 Duct
Sliding Damper
16"×4" Slot with Copper Screen
Wall
2"×2"×⅛" Angle Bracket Bolted to Wall and Angle Frame

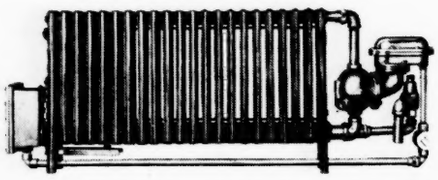
Hood for ventilation of receiving and working area in china department of store. (Left) Plan: (Above) Section AA.

NEWS OF EQUIPMENT AND MATERIALS

Burnham Electric Radiator

NAME — Burnham explosion-proof electric radiator.

PURPOSE—Heating unit for use in atmospheres containing vaporized petroleum products, butane, alco-



hol, acetane and natural gas and substances such as carbon black, coal, coke, flour, starch and grain dusts.

FEATURES—Unit is completely electrical in operation with thermostatically controlled heat output. All electrical switches and connections are sealed in heavy cast iron housings. Automatic controls prevent internal pressure from building up above 30 lb. Radiators are hydrostatically tested for pressures up to 140 lb. Radiator tubes are cast iron. Radiator comes filled with a solution of water and a Prestone type anti-freeze. This solution is heated by an immersion type calrod electric unit. A flat-operated switch shuts off current if, through neglect, the water level should drop below the float level. A mechanical relief valve operates should the pressure reach 30 lb.

MADE BY — *Burnham Corp., Electric Radiator Department, Irvington, N. Y.*

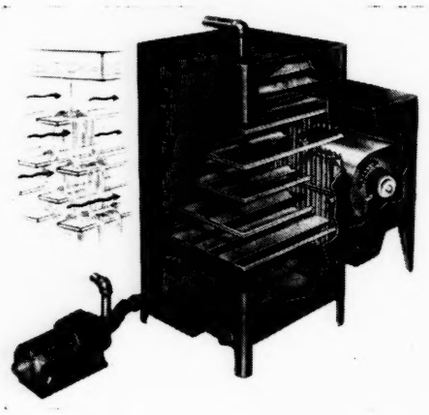
Item 1

Binks Cooling Tower

NAME—Binks type E induced draft cooling tower.

PURPOSE—Blower type cooling tower designed for small packaged water-cooled air conditioning and refrigeration condensing units up to 6 tons.

FEATURES—Assembly consists of a belt-driven blower operating at slow speed. Induced draft is obtained through air intake louvers located in the rear of the unit. Warm water is delivered to a perforated water diffusion pan at the top of the tower from which point it is evenly distributed by gravity to underlying cascade type deck surfaces. Zigzag three-pass drift eliminators prevent free moisture from entering the plenum chamber surrounding the blower assembly. For indoor installations, discharge air from the tower should be vented to the outdoors through suitable duct work. Blower is furnished complete with scroll and 1/3-hp ball bearing motor with hinged type mounting to provide for automatic belt take-up. A separate motor drives the water circulating pump. Shipment is made in two parts—one consists of the tower proper and the other the air propulsion unit. All water connections are provided.



LITERATURE AVAILABLE — Bulletin 42.

MADE BY—*Binks Manufacturing Co., 3122 Carroll Ave., Chicago 12, Ill.*

Item 2

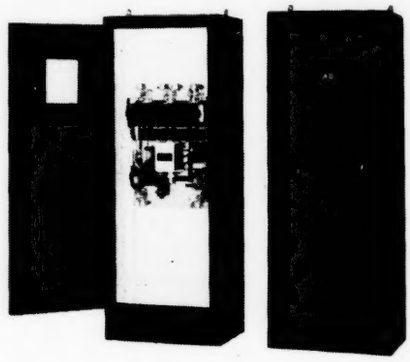
Allen-Bradley Starter

NAME—Allen-Bradley solenoid starter, Bulletin 709.

PURPOSE — Solenoid starters for alternating-current motors.

FEATURES — Switch construction follows the familiar solenoid design of the company for sizes 0 to 5, inclusive. Units have one-piece magnetic plunger which operates with a vertical straight line motion. The fully enclosed double break, silver alloy contacts are said to require no cleaning or filing. Solenoids are energized with direct current drawn from a self-contained selenium rectifier. All terminals and wiring are accessible from the front. There is no back-of-panel wiring.

SIZES AND CAPACITIES—Size 6 is



rated at 600 amperes and size 7 is rated at 900 amperes.

MADE BY—*Allen-Bradley Co., Milwaukee, Wis.*

Item 3

Plastic Slide Rule

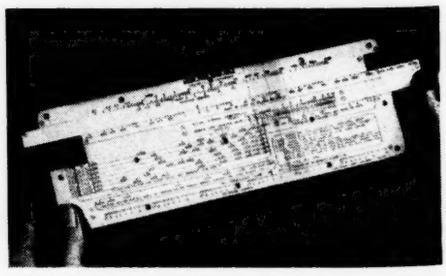
NAME—Liquid flow slide rule.

PURPOSE—Slide rule for computing problems in the flow of liquids through commercial pipes and tubing.

FEATURES—Instrument is made of Vinylite sheet plastic to insure constant accuracy of the instrument. The slide rule solves the Fanning equation and may be used to calculate pressure drop, pipe diameter or rate of flow for any liquid of known viscosity and density. Can be used for solving problems in either turbulent or streamline flow. The rule automatically indicates which type of flow exists in a given problem. Slide rule measures 10½ inches long by 3¾ inches wide.

DISTRIBUTED BY—*C. J. Major, 2252 15th St., Wyandotte, Mich.*

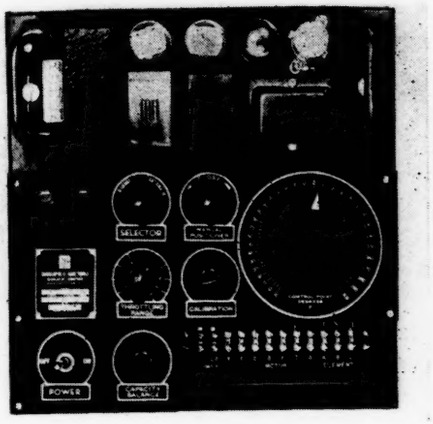
Item 4



M-H Electronic Control

NAME — Minneapolis - Honeywell electronic control, No. 077.

PURPOSE—Electronically controlled instrument for industrial applications where high temperature sensitivity is required.



FEATURES — Device is said to control industrial processing temperatures in which the temperature range is between 20 to 300F. It is said to be sensitive to temperature changes as small as 0.1F, and also to be immune to vibration, dust and dampness. Where both control and a record are required, it may be used with indicating or recording instruments. Unit operates on the principle that resistance of a wire-wound sensing element varies in proportion to the temperature of the control medium. The sensing element forms one leg of a Wheatstone bridge circuit so that any minute change in temperature causes the bridge to become unbalanced and permits current to flow. Electrical unbalance of this bridge is imposed on an electronic amplifier which amplifies and detects the direction of unbalance to operate either of two output relays, according to the direction of temperature change. These two relays control a motor.

MADE BY—*Minneapolis-Honeywell Regulator Co., Minneapolis, Minn.*

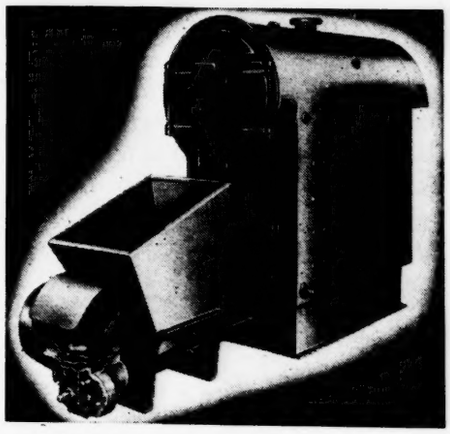
Item 5

Unitbilt Boiler-Stoker

NAME — Brownell Unitbilt boiler stoker.

PURPOSE—Stoker-fired boiler for steam generation.

FEATURES — An added feature of the unit makes the base an integral part of the boiler by extending the inner firebox plates so the boiler and base are actually of one-piece construction. Tapered water legs, it is said, permit expansion of water and improved heat transfer. A large combustion chamber is provided. A rear service door gives access to the back of the boiler for cleaning and tube replacement. The Brownell stoker has gears which run in an oil bath while tubes and troughs convey lubrication to the various bearings. Water accumulated in the gear case is indicated by overflow from the oil level cup. The motor can be lowered by lever to slacken belt for shifting from one set of sheave grooves to another. If pin on driveshaft is sheared, a safety cut-out switch is thrown and the motor is stopped. A venturi prevents gas and smoke



blow-back through coal feed tube.

SIZES AND CAPACITIES — Available in ten sizes with steam radiation capacities of 2,190 to 8,500 sq ft.

LITERATURE AVAILABLE — Bulletin SF-1.

MADE BY—*The Brownell Company, 410 N. Findlay St., Dayton 1, Ohio.*

Item 6

Polyken Tape

NAME—Polyken industrial tape.

PURPOSE—Tape to provide corrosion protection.

FEATURES — Tape is an oriented polyethylene film with a synthetic adhesive applied to one side. Film is said to have good electrical and chemical resistance properties. Tape applies a permanent pressure around the coated metal equal to tension used in applying it. Tape, which is 0.009 inch thick and is available in aluminum or black, is supplied on cores in widths from 1½ to 3 inches and in 100-ft rolls.

MADE BY—Bauer & Black, 222 W. Adams St., Chicago 6, Ill.

DISTRIBUTED BY—*Plastic Engineering & Sales Corp., P. O. Box 1037, Ft. Worth, Tex.*

Item 7

G-E Temperature Indicators

NAME—General Electric temperature indicators.

PURPOSE—Measurement of temperature for industrial and laboratory use.

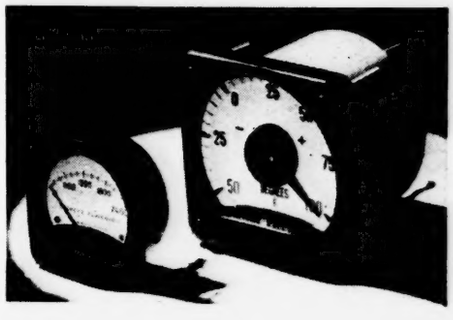
FEATURES — Resistance thermometers are designed for measurement of low temperatures and are applicable for a range up to 300F. Operation of the thermometer is based on the principle that the electrical resistance of a metallic conductor will increase as its temperature increases. Essentially this instrument is a milliammeter which measures current change in a varying resistance across a fixed voltage which, in turn, is calibrated in temperature units. The use of a bridge circuit and constant voltage supply in combination with the resistance element and milliammeter makes the instrument, it is said, substantially free from errors due to normal line voltage variations.

SIZES AND CAPACITIES — Available in two sizes—Type DO-71 with a 3½-inch flange and type DW-71 with a 2½-inch flange. Both types can be supplied in either square or round molded Textolite cases.

LITERATURE AVAILABLE — Bulletin GEC-565.

MADE BY—*General Electric Co., Schenectady 5, N. Y.*

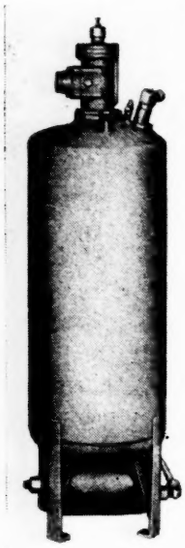
Item 8



Temprite Liquid Cooler

NAME—Temprite industrial liquid cooler.

PURPOSE—Liquid cooler for use in air conditioning and process cooling work in many industrial fields.



FEATURES—Unit operates on the high side float to provide instantaneous heat transfer from the liquid to the refrigerant. Makers claim economical operation is insured as liquid is cooled only as required. A continuous coil closed system prevents contamination and eliminates atmospheric exposure. Copper coils are used in all WB models. Units are bottom connected for ease of complete draining or to prevent stagnation or freeze-up. A constant temperature control valve automatically maintains constant temperature at any desired point. Coolers operate with refrigerant temperature only 4F lower than the desired exit temperature, omitting the use of the high suction pressure condensing unit.

SIZES AND CAPACITIES — Available in four models with refrigeration charges from 35 to 90 lb.

LITERATURE AVAILABLE—Illustrated bulletin.

MADE BY—*Temprite Products Corporation, 47 Piquette Ave., Detroit 2, Mich.*

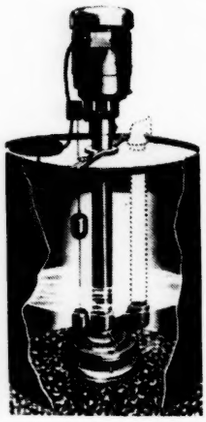
Item 9

Deming Sump Pump

NAME — Deming sump pump No. 4607.

PURPOSE—For serving as a cellar drainer and for removing water from sumps or low points.

FEATURES — The centrifugal type pump has a bronze impeller fastened to the stainless steel shaft. A large bronze bearing supports the shaft. The float switch has two-pole snap-action silver contacts operated by two small non-breakable weights. A stainless steel cable moves only ½ inch to operate the switch. There are no guides for the float. Strainer is made of heavy construction perforated brass. If specified, a split cast iron sump cover is supplied at extra cost, to fit in the bell of an 18- or 24-inch tile. Pump motor operates on 115 to 230 volt, a-c, 60 cycle, single phase current and at a speed of 1750 rpm.



SIZES AND CAPACITIES—Two models available—one operated by a 1/3-hp motor for 60 gpm, at a 15 ft head. Other unit is operated by a ½-hp motor for 80 gpm at 15 ft head. Both units are available with lengths for sumps of 2, 3, 4, and 5 ft in depth.

MADE BY—*The Deming Co., Salem, Ohio.*

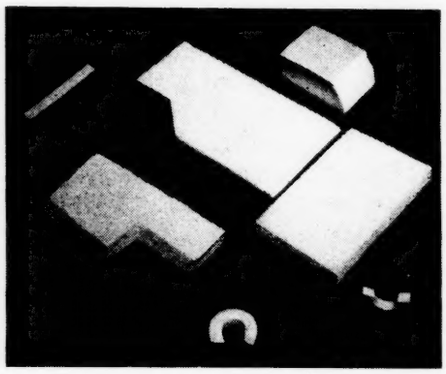
Item 10

Molded Sponge Rubber

NAME—Molded silicone rubber.

PURPOSE — Specially formed synthetic silicone rubber for use as insulation against shock, vibration, and sound, and also for use in low temperature work.

FEATURES—Product can be supplied in sheets or strips and tubes and also in die-cut shapes or molded forms. Cell structure may be of chemically blown interconnecting cells or non-interconnecting cells.



Product is said to maintain its efficiency at temperatures as low as —70F. It is said to have a chemical stability superior to natural cellular rubber.

MADE BY — *The Sponge Rubber Products Co., Shelton, Conn.*

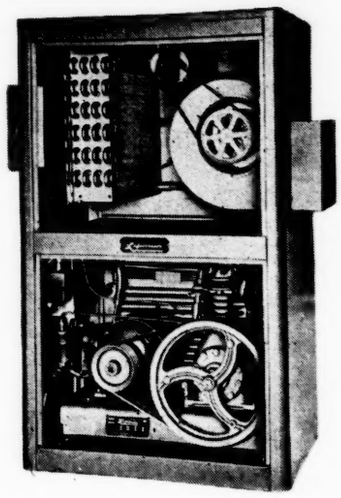
Item 11

Lipman Home Cooler

NAME — Lipman Residence Cooler, type L-310.

PURPOSE—Home air conditioning.

FEATURES—The unit is placed in the basement where it is out of the way and convenient to water and electrical connections. It operates through the ductwork of a blower type warm air furnace, saving the expense of extensive remodeling and structural changes. The cooling coils are four rows deep for maximum cooling and dehumidification. All air, whether recirculated or outside, passes through permanent, cleanable filters where dust, pollen and other particles are removed. The cooled air is then forced through the ducts by a large capacity blower. The compressor is a reciprocating, heavy duty 3 hp Lipman unit. Extra quietness is assured by a thick layer of rigid sound deadening insulation.



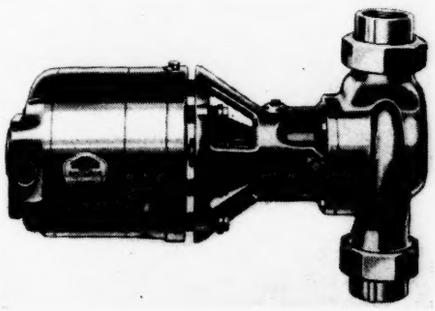
SIZES AND CAPACITIES—3 tons of refrigeration. Length, 36 inches; width, 23⅜ inches; height, 60 inches; weight, 1,000 lb.

MADE BY — *General Refrigeration Div., Yates-American Machine Co., Beloit, Wis.*

Item 12

Thrush Circulator

NAME — Thrush horizontal water circulator.
PURPOSE— To promote flow in hot water heating systems and for use in domestic water supply systems.

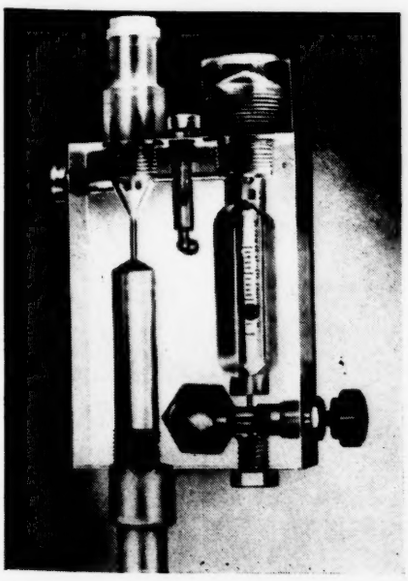


FEATURES—Pump has an oil lubricated bearing. Polished and ground stainless steel shaft is used with brass impeller and impeller plates. Unit has a flexible spring coupling. Installed on the unit is a side outlet motor junction box. Motors are 60 cycles provided with automatic thermal protection.
SIZES AND CAPACITIES — Available in six sizes for 1, 1¼, 1½, 2, 2½ and 3 inch pipe connections. Three largest sizes have flange connections.
MADE BY—*H. A. Thrush & Co., Peru, Ind.*

Item 13

Feed-Rator Feeder

NAME—Feed-Rator.
PURPOSE — A self-contained chemical feeder for simultaneously controlling, metering and dispensing small amounts of chemicals or solutions into liquid streams under pressure.

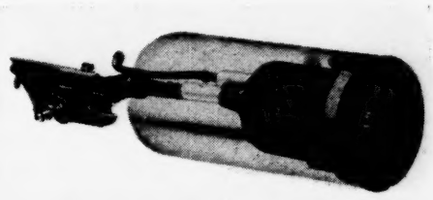


FEATURES—A built-in eductor takes the place of a pump so that highly corrosive chemicals can be fed directly from a container. Body is made of transparent, polished acrylic plastic. The eductor is capable of handling 5 gpm. The Flowrator meter on the reagent side has a capacity of 1 gpm and the minimum ratio of main stream to the reagent stream is 2½ to 1 on water. This ratio applies for 25 lb main stream pressure, with the reagent at atmospheric pressure. Valve plug and seat are of corrosion-resistant material.
OPERATION — Main stream line is connected to the eductor at the top of the plastic block. Flow through the eductor creates a partial vacuum on the reagent side and this vacuum induces a flow of reagent through the needle control valve, through the Flowrator metering tube and into the mixing chamber where thorough mixing takes place. Reagent flow rate is controlled by the built-in needle valve and is indicated by the float. A ball check valve provides flow of main stream liquid into the reagent line on shutdown. A vacuum breaker is provided for use in gas service.
SIZES AND CAPACITIES—Unit measures 10 x 5 x 2 inches.
LITERATURE AVAILABLE — Catalog No. 62.
MADE BY — *Fischer & Porter Co., Hatboro, Pa.*

Item 14

Century Oil Burner

NAME—Century oil burner.
PURPOSE — New firing head for Century oil burners.
FEATURES—The new firing head that is used with these oil burners is said to permit more accurate adjustment of the flame to reduce caking or carbonizing and to keep both nozzle and electrodes clean for longer periods of time. Electrodes and nozzle are used in a separate shell within the manifold tube. The inner assembly can be quickly moved forward or back to adjust the ratio of primary to secondary air for best combustion. This new design is said to assure constant air pressure and volume around the nozzle while providing for varying the amount of secondary air that passes around the



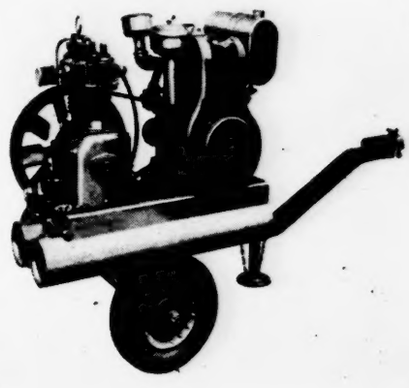
outside of the nozzle electrode tube to the combustion chamber. This firing head is standard equipment on both the Model L and cushion-cradled Model O furnace in sizes up to 5 gph. Conversion kits are available for adding this head to Model L burners already installed.
MADE BY — *Century Engineering Corp., Cedar Rapids, Iowa.*

Item 15

Gardner-Denver Compressor

NAME — Gardner - Denver trailer mounted compressor.
PURPOSE—Portable compressor unit for operating small air tools.
FEATURES — The air-cooled compressor is provided with a V-belt drive to the gasoline engine and is mounted on a pipe tank type base. Unit has semi-pneumatic rubber tired bearing wheels, drawbar, trailer hitch and stabilizer leg. Compressor has a forged steel crankshaft supported on both sides of the throw by adjustable Timken roller bearings.
MADE BY — *Gardner-Denver Company, Quincy, Ill.*

Item 16



Vent-Rite Valve

NAME — Vent-Rite main vent No. 99.

PURPOSE—For venting mains connected to automatically fired heating system.

FEATURES — Valve is of the non-adjustable type which can be taken apart for cleaning and servicing. Unit is said to have large venting capacity which makes possible fast venting of mains. In this way the entire main is filled with steam before distribution through risers and runouts are started. Vent is only for use on low presure systems.

SIZES AND CAPACITIES — Overall height, 4¼ inches. Unit is provided with a ¾ inch male and ½ inch female bottom connection.

MADE BY—*Anderson Products, Inc., 19 Tudor St., Cambridge 39, Mass.*

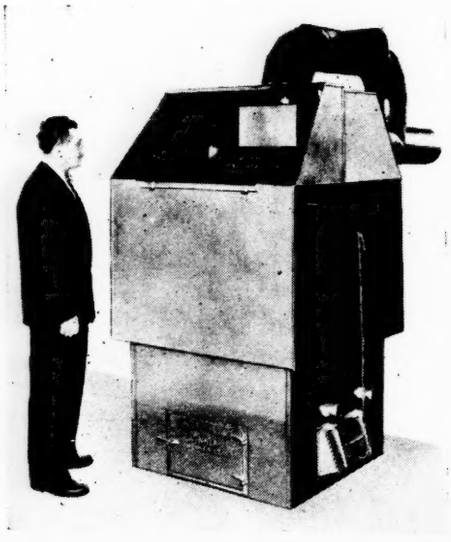
Item 17

Winnen Incinerator

NAME—Winnen CB-20 incinerator.

PURPOSE—Gas-fired incinerator for use in hotels, stores, apartments and schools.

FEATURES—Unit is shipped knocked down to be installed on the site. Incinerator is constructed of heavy gauge bonderized steel. It has a 20-bushel capacity combustion chamber lined with fireproof Haydite slabs. Makers claim the unit consumes 400 lb of 50% moisture content garbage or trash per hour. A twin-burner mechanism provides a hot, intense flame with either natural, manufactured or bottled gas. The 1/3 hp squirrel-cage blower fan supplies forced draft through the unit. Makers claim that the unit insures complete dehydration and combustion of the refuse without smoke and odor developing inside the building. Ashes are removed through grate door located in the front of the unit.



SIZES AND CAPACITIES—Height, 84 inches; width, 41 inches; length, 41 inches.

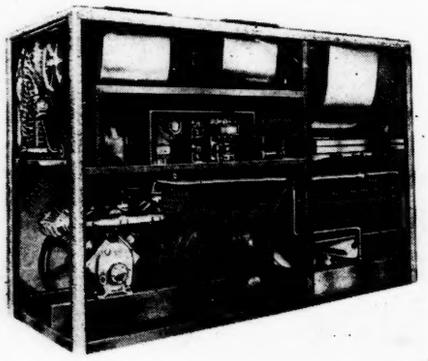
MADE BY — *Ramsey-Bennett Co., 430 Huron Rd., Cleveland 15, Ohio.*

Item 18

Nevinger Air Conditioner

NAME — Nevinger air conditioner, model AEC.

PURPOSE — Complete air conditioning system, supplied as a factory assembled unit, for either cooling or heating.



FEATURES — Included in the completely assembled package is a condensing unit, blower coil section, and evaporative condenser. All models are equipped with a 4-cylinder V-type slow speed compressor. Cooling coil consists of aluminum fins on copper tubes with the tubes expanded to assure good bonding with the fins. The compressor motor is of the ball bearing type and drives the compressor with three or more V-belts. Twin centrifugal type blowers are used. The evaporative condenser fan and housing are hot-dip galvanized for maximum life. All controls are enclosed in a heavy gage steel cabinet readily accessible by raising hinged steel door. Controls consist of the across-the-line type starter, Hi-Lo pressure control, and suction and air pressure gages. The condenser section is complete with air filter coils, expansion valve, heat exchanger and blowers. Completely insulated with ½ inch rigid board type material.

SIZES AND CAPACITIES — Available in 7 sizes ranging from 5 to 30 hp. A 40 hp unit is available on special order.

MADE BY — *Nevinger Manufacturing Co., Inc., Greenville, Ill.*

Item 19

Jabsco Pump Control

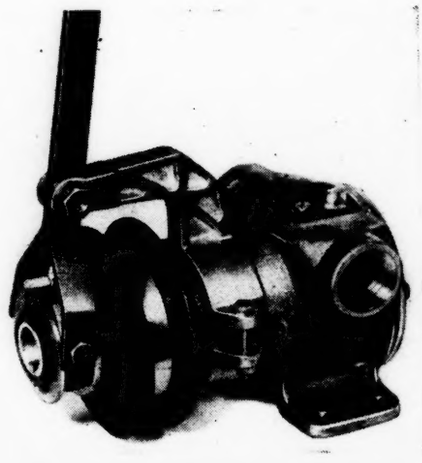
NAME—Jabsco pump clutch control.

PURPOSE—A throw-out clutch designed to simplify the driving hook-up of Jabsco industrial pumps.

FEATURES — Clutch mechanism is designed to permit the pump to be engaged or disengaged at the throw of a small control handle. It uses a ball lock and V-belt mechanism which is attached to and supported by the pump shaft. The control linkage mount on the housing of the pump requires only a single bolt fastening. Since the clutch attaches directly to the pump shaft the need for an additional shaft or outboard bearing is eliminated. The control linkage may be mounted at any point on a full 360 deg periphery. At present, control is made for Jabsco pump Model 832 but other sizes will be available soon.

MADE BY—*Jabsco Pump Co., 2031 N. Lincoln St., Burbank, Calif.*

Item 20



F & W Varijet Pump

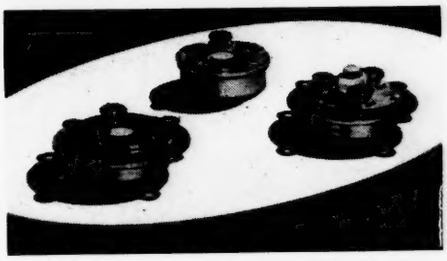
NAME—F & W Varijet pump.
PURPOSE—Pump for use in shallow well installations where the suction lift is not more than 25 ft.

FEATURES — Pump unit consists of pump motor, pressure switch, and foot valve. In addition, there is the galvanized pneumatic tank, air volume control and pipe fittings from pump to tank. The pressure switch maintains a correct amount of pressure in the pneumatic tank at all times while the air volume control regulates the proper ratio of air and water. Motors are heavy duty long hour capacitor type operating at 3,450 rpm and are supplied for 110-220 volt, 60 cycle single phase current. Motors are provided with overload protection and automatic reset.
SIZES AND CAPACITIES — Available in four sizes with motor size ranging from ¼ to ¾ hp and for supplying water from 450 to 1,080 gph.
LITERATURE AVAILABLE—Folder.
MADE BY—*Flint & Walling Manufacturing Co., Inc., Kendallville, Ind.*

Item 21

Klixon Thermostat

NAME — Klixon thermostat type C 4370.
PURPOSE — An enclosed type fixed temperature snap action thermostat for use with small water or space heaters or any other product requiring non-adjustable fixed temperature control.
FEATURES—The Spencer disc is used which eliminates the necessity for magnets or relays. Thermostats can be mounted in recess wells and castings and in space for control of air temperature. They are available with bottom mounting flange, top mounting flange and shoulder mountings. They are approved by Underwriters' Laboratories for use where proper terminal enclosure is provided.
SIZES AND CAPACITIES — Available with fixed temperature differentials and settings from —10 to 550F. Unit has a motor load rating of 1/4 hp, 120 to 240 volts a-c, and a private duty rating of 125 volts-amperes, 120-124 volts a-c. Maximum recommended d-c rating is 12 amperes for 30 volt d-c, and 1 ampere for 125 volts d-c.

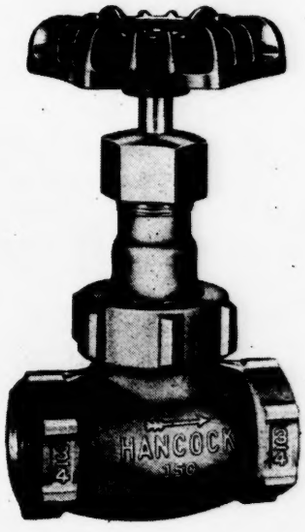


MADE BY—*Spencer Thermostat Division, Metals and Controls, Corp., Attleboro, Mass.*

Item 22

Hancock Bronze Valve

NAME — Hancock 150 lb bronze valve.
PURPOSE—Fluid and steam control.
FEATURES—This new line of valves is provided with stainless steel seats and discs and a diaphragm construction that is claimed to be 125 to 230% stronger than the usual type bronze valve. Removable plug seats and discs are treated to 500 Brinell hardness and then honed to a mirror-like finish. The stem is of aluminum silicon bronze. The body, bonnet and bonnet ring are made of steam bronze.
SIZES AND CAPACITIES — In eight sizes from ¼ to 2 inches inclusive, and for pressures up to 150 lb for saturated steam, and 300 lb for non-shock cold water, oil or gas.
LITERATURE AVAILABLE — Bulletin.
MADE BY — *Manning, Maxwell & Moore, Inc., Watertown 72, Mass.*

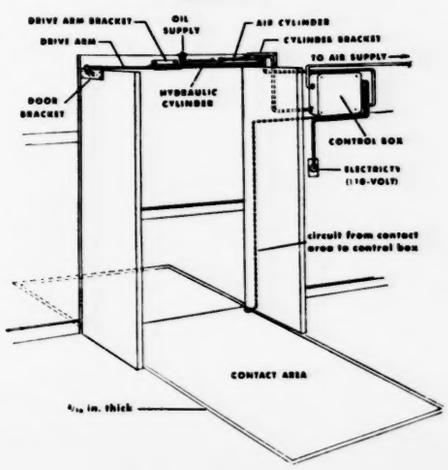


Item 23

Automatic Door Control

NAME—Astra door control.
PURPOSE—For automatically opening and closing doors to permit passage of persons, and to reduce drafts, inlet of cold air, and harmful passage of fumes, dust and lint.
FEATURES—Door opening is electrically initiated by walking on floor area either side of door. Opening and closing of doors is air operated and hydraulically controlled. Air power is supplied by building's regular air pressure system and electricity from 110-volt wall outlet. When building air supply is not available air may be furnished from small compressors. In case of a power failure in building, doors can be manually operated. Can be installed without any remodeling of doors, walls or floors.
MADE BY—*Astra Engineering Co., 327½ West Broadway, Glendale 4, Calif.*

Item 24



Hammel-Dahl Valve

NAME — Hammel-Dahl diaphragm control valve, series 2000.

PURPOSE—Valve designed to handle corrosive fluids, gases, or slurry.

FEATURES—Body of valve is streamlined with an absence of pockets. A compressor or foot is attached to the upper side of the valve diaphragm. Tight shut-off is obtained when the diaphragm is brought firmly in contact with the transverse weir. Standard valve action is spring opening, air to close. For normally closed air to open action a preloaded or springless dome is available. Valve can be supplied with cast iron bodies, cast iron bodies with rubber, glass or lead lining, as well as stainless, monel, Everdur, nickel, Duriron and aluminum. Standard body diaphragm is either rubber or neoprene. Valve has a positioner to indicate percentage opening.

SIZES AND CAPACITIES — Available in sizes up to 12 inches. The 4-inch size is rated at a maximum working pressure of 150 lb per sq in., while the 10- and 12-inch is rated at 65 lb per sq in.

MADE BY—*Hammel-Dahl Company, 243 Richmond St., Providence 3, R. I.*

Item 25

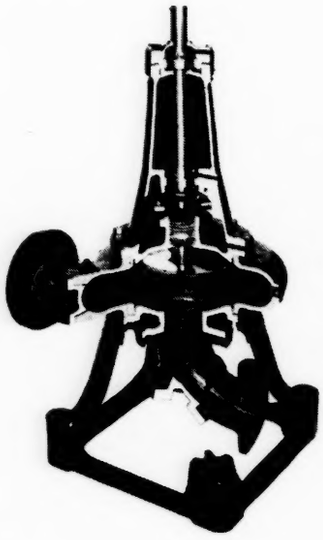
Fairbanks Bladeless Pump

NAME—Fairbanks bladeless trash pump.

PURPOSE—Pumping unit for handling trash and slurries.

FEATURES—The impeller is bladeless, having no vanes or blades on which solid material can catch. Instead, the fluid passes through impeller through a single rotating channel or passageway with the centrifugal force doing the work. Wound somewhat like a corkscrew, this curved channel starts at a small radius at the axis of rotation and then fans out in a helical path. This centrifugal action throws the fluid against the sides of the bent channel or passageway and because these slant forward, the fluid carrying the solids and trash is driven along the channel. This achieves the pumping action. The diameter of the rotating channel at its narrowest point is equal to the diameter of the inlet pipe. Therefore, almost anything that would enter the eye of the impeller would be carried through without clogging. Makers claim that this unit will result in reduced maintenance and the use of small driving motors.

SIZES AND CAPACITIES — Available in sizes from 2 to 5 inches.



MADE BY—*Fairbanks, Morse & Co., 600 South Michigan Ave., Chicago 5, Ill.*

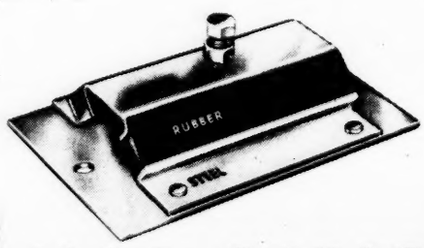
Item 26

Finnflex Vibration Isolator

NAME—Finnflex vibration isolator, type SP-9.

PURPOSE—Mount to isolate machinery vibration.

FEATURES—Unit consists of a steel channel floating in rubber between two steel angles which, in turn, are welded to a steel plate for bolting down. Makers claim that since the spring index is not constant, resonance is avoided. Mounts provide for a specific load from 40 to 3,000 lb each.



SIZES AND CAPACITIES — Available in lengths up to 30 inches and in four grades of rubber stiffnesses for loads of 40, 50, 70 and 105 lb per inch of length at 1/4-inch deflection.

MADE BY—*Finn & Co., 2850 Eighth Ave., New York 30, N. Y.*

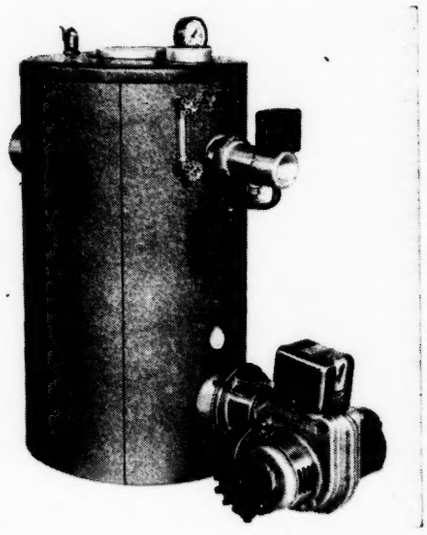
Item 27

Delta Boiler

NAME—Delta boiler and burner unit, Model LA-300.

PURPOSE—Space heating for small homes.

FEATURES—Designed for the small home, this unit is small in size to permit installation in utility rooms. Of ASME steel construction, it is provided with a ¼-inch shell, 10-gage boiler tubes, and 5/16-inch crown sheets. Unit is fired with a flange mounted 1 gph gun type burner. Boiler is designed for either steam or hot water heating systems and is equipped with built-in tankless coil capable of supplying domestic hot water.



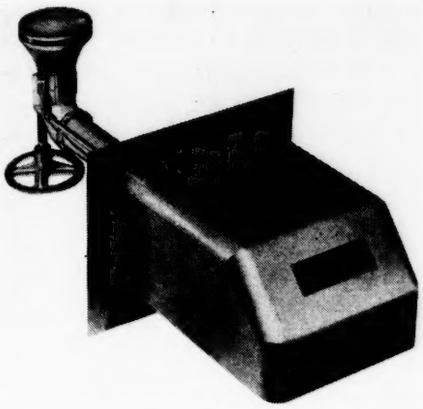
SIZES AND CAPACITIES—Net rating of 320 sq ft for steam and 510 sq ft for hot water radiation.

MADE BY—*Delta Heating Corp., 85-07 Northern Blvd., Jackson Heights, N. Y.*

Item 28

Bryant Conversion Burner

NAME—Sphinx-ette.
PURPOSE—Automatic gas conversion burner for all types of gas.

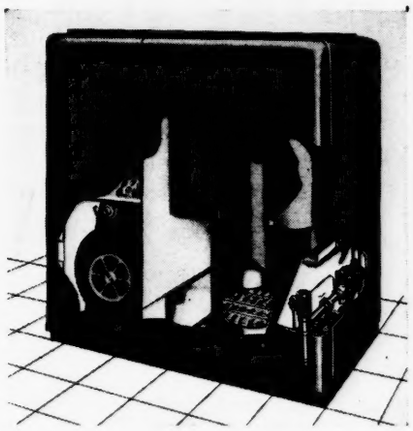


FEATURES—Unit is a universal, adjustable conversion unit for all types of gas and for small and medium sized heating plants. An all-cast burner head is provided. A needle valve adjustable orifice is installed for quiet operation. Burner has exterior primary air control and an adjustable secondary air door. It also has a main shut-off valve and a pilot valve. Purchaser has choice of Minneapolis-Honeywell, General, or Gleason-Avery controls. Unit is fully assembled and shipped ready for installation, complete with height adjusting studs. There are no refractories to preheat so that heating is said to be more instantaneous and more flexible. Precision-machined slip-tube adjustment provides for easy installation in all units.
MADE BY—*C. L. Bryant Corp., 4610 St. Clair Ave., Cleveland 3, Ohio.*

Item 29

Master Kraft Furnace

NAME — Master Kraft gas-fired warm air conditioner.
PURPOSE—Space heating.
FEATURES — Combustion chamber has been designed to eliminate hot and cold spots. The new design is said to provide a heat travel to obtain the maximum heat transfer. Unit has been approved by the AGA laboratories.
SIZES AND CAPACITIES — Available in four models with inputs of 70,000 to 210,000 Btu per hr and with blower capacities from 670 to 1,520 cfm. The blower wheel diameter ranges from 9 to 14 inches.
LITERATURE AVAILABLE—Bulletin.



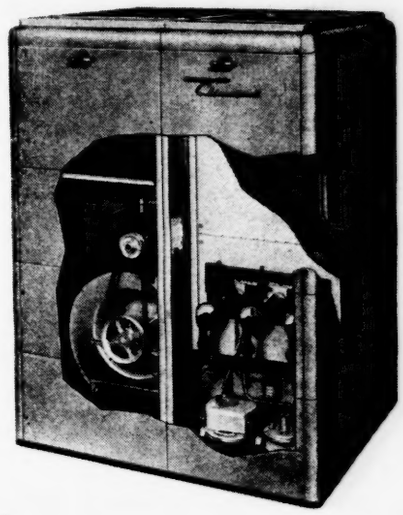
MADE BY — *Harvey-Whipple, Inc., Springfield, Mass.*

Item 30

Mueller Climatrol

NAME — Mueller Climatrol, Model No. 108.
PURPOSE—Gas-fired warm air furnace for space heating.
FEATURES—Furnace is a low-boy unit which can be installed with the blower compartment at either the right or left side of the heat exchanger. Furnace has a sectional heat exchanger, each section of which is of one-piece construction and formed of corrosion-resistant, chrome alloy. Cast inside each section are more than 400 heat extracting pins that are staggered to promote the extraction of heat from the hot flue gases. Vertical ribs are cast into outer walls for additional heat-transmitting surface. Sections are bolted to a common pouch with a sealed, gas-tight, tongue- and-groove fit. Heat exchanger is mounted on a frame, with leveling screws. Each heating section is fired by an individual, drilled port cast iron burner, an intercommunicating design and mounted in a common pouch.
SIZES AND CAPACITIES — Available in six sizes with inputs ranging from 67,500 to 157,000 Btu. Available for operation with natural, mixed or manufactured gas.
MADE BY — *L. J. Mueller Furnace Co., 2005 W. Oklahoma Ave.. Milwaukee 15, Wis.*

Item 31



JANUARY, 1950

TO OBTAIN FURTHER INFORMATION ON NEW EQUIPMENT

On the list below, circle the item number of the equipment in which you are interested, using the number found at the end of each item.

1	2	3	4	5	6	7	8
9	10	11	12	13	14	15	16
17	18	19	20	21	22	23	24
25	26	27	28	29	30	31	

Print your name and address, detach and mail to
Editor, HEATING AND VENTILATING, 148 Lafayette St., New York 13, N. Y.

Name.....

Title (Must be shown).....

Firm (Must be shown).....
(For prompt service, title and firm name must be shown above.)

Business Address.....

City.....Zone....State.....1/50

Abstracts AND Reviews

Publications abstracted in this department should be ordered direct from publisher.

ABBREVIATIONS AND SYMBOLS

An extensive work on Scientific and Technical Abbreviations, Signs and Symbols, was first published in 1948. This work by Dr. O. T. Zimmerman, professor of chemical engineering, University of New Hampshire, and Dr. Irvin Lavine, formerly professor of chemical engineering and head of department, University of North Dakota, was so well received that a second edition has just been published.

Here, grouped in a manner that they will be easy to find, are the important abbreviations, signs and symbols used in engineering, mathematics, chemistry, physics, thermodynamics, aeronautics, radio, electronics, hydrography, topography, meteorology, astronomy, zoology, botany, medicine, communications, commerce and banking, machine and tool shops, and a number of other fields.

This is an outstanding compilation which, among other things, may result in a greater uniformity of abbreviations, signs and symbols.

Since the first edition, important developments have taken place. New American Standards were issued for physics, electrical quantities, and aeronautical and aerodynamics; the U. S. Weather Bureau adopted the International Weather Code; and other new material was made available.

Scientific and Technical Abbreviations, Signs and Symbols, by O. T. Zimmerman and Irvin Lavine. Cloth bound, 5½ x 8½ inches. 541 pages. Published by Industrial Research Service, Dover, N. H.

ESTIMATING MANUAL

Information of value to those engaged in estimating the time required to fabricate and erect steel piping in heating and plumbing systems, is easily accessible in the Estimating Manual for Heating and Piping Systems, by Harry A. Erickson.

Included are 70 tables listing the time required for different piping operations. These tables give the time required for setting sleeves, setting inserts, erecting typical pipe hanger brackets, handling one- and two-pipe risers, radiator branches, unit heater connections, cutting and threading pipe, and making up screwed fittings.

While the author does not claim that this is a complete treatise on the subject, he hopes that it may prove helpful to the contractor in estimating the time required for the installation of heating and piping systems.

Estimating Manual for Heating and Piping Systems, by Harry A. Erickson. Cloth bound, 5 x 7½ inches, 112 pages. Published by Plumbing and Heating Journal, 45 W. 45th St., New York 19, New York. Price, $3.

SOLAR AND SKY RADIATION—"Weekly Mean Values of Daily Total Solar and Sky Radiation," is available as a Weather Bureau Technical Paper No. L11. It presents graphically the weekly mean values of daily total solar and sky radiation received on a horizontal surface at the Weather Bureau and cooperating stations during the last 35 years. Price, 15 cents. Superintendant of Documents, U. S. Government Printing Office, Washington 25, D. C.

STYLE MANUAL FOR AMERICAN STANDARDS—A manual has been produced by the American Standards Association to bring about greater uniformity in presenting technical data. Although primarily intended for use by the technical committees working under the ASA, it is believed that the manual contains suggestions that may be helpful to others. The principle sections include suggestions for outline form and numbering, capitalization, punctuation, spelling, abbreviations for technical terms, bibliographical style, and rules for tables and illustrations. American Standards Association, 70 E. 45th St., New York 17, N. Y. Price, $1.00.

MASONRY CHIMNEYS FOR HOUSES — In Technical Paper No. 13 on the "Performance of Masonry Chimneys for Houses," published by the Housing and Home Finance Agency, is presented improvements in chimney design and construction. The laboratory research in connection with this undertaking was performed as a joint project of the HHFA and the National Bureau of Standards. A number of test chimneys were constructed and tested. This 46-page paper covers chimney performance requirements, code practices, tests, and recommendations. For a copy write to Housing and Home Finance Agency, Washington 25, D. C.

SHORT COURSE ON INSTRUMENTATION—Bulletin No. 111, issued by the Texas Engineering Experiment Station of the A & M College of Texas, contains papers and discussions presented at the Third Annual Short Course on Instrumentation for the Process Industries that was held at College Station, Texas, October 26 to 28, 1948. This bulletin contains ten of the talks given at this school, together with some of the discussions of the various papers. Texas Engineering Experiment Station, College Station, Texas.

PIPE FABRICATION STANDARDS—Three new standards have been adopted and published by The Pipe Fabrication Institute. Standard ES2-1949 covers the method of dimensioning welded assemblies. Standard ES3-1949 on linear tolerances, bending radii, and minimum tangents has a table which gives this information for pipe sizes from 1 to 24-inch O.D. Standard ES4-1949 is a single sheet that covers standard practice on shop hydrostatic testing of fabricated piping. For copies write to the institute at 1108 Clark Building, Pittsburgh 22, Pa.

DEGREE-DAYS FOR NOVEMBER, 1949

(A) Airport readings (C) City office readings; (O) Readings at a point on outskirts of city.

HEATING AND VENTILATING'S 22nd Year of Publication of Monthly Degree-Day Data

City	November			Cumulative, September 1 to November30			Heating Season[1]
	1949	1948	Normal	1948-49	1947-48	Normal	Normal
Abilene, Texas (A)	214	378	333	357	488	333	2061
Albany, New York (A)	837	598	774	1403	1243	1292	6580
Albuquerque, New Mexico (A)	426	733	630	722	1057	903	4298
Alpena, Michigan (C)	910	701	912	1587	1380	1704	8299*
Anaconda, Montana (C)	710	1083	951	1841	1999	1933	8357**
Asheville, North Carolina (C)	(a)	423	576	(a)	799	852	4232
Atlanta, Georgia (C)	(a)	310	396	(a)	474	492	2890
Atlantic City, New Jersey (C)	502	375	588	676	683	842	5176
Augusta, Georgia (A)	(a)	173	321	(a)	297	337	2161
Baker, Oregon (C)	660	954	849	1510	1765	1659	7163
Baltimore, Maryland (C)	488	363	567	633	656	790	4533
Billings, Montana (A)	525	863	909	1445	1432	1622	7119
Binghamton, New York (C)	778	562	798	1293	1176	1359	6808
Birmingham, Alabama (A)	(a)	321	318	(a)	479	318	2352
Bismarck, North Dakota (A)	776	1006	1113	1694	1691	1961	9192
Block Island, Rhode Island (C)	561	430	573	830	807	852	5788
Boise, Idaho (A)	613	839	738	1279	1388	1274	5552
Boston, Massachusetts (A)	644	461	693	979	878	1104	6045
Boseman, Montana (C)	689	1053	1006	1788	1860	1993	8521**
Buffalo, New York (A)	811	536	774	1290	1107	1268	6822
Burlington, Iowa (A)	659	709	(a)	1125	1171	(a)	(a)
Burlington, Vermont (A)	950	619	861	1525	1361	1486	7514
Butte, Montana (C)	733	1114	923	1910	2104	1922	8235**
Cairo, Illinois (C)	466	439	519	654	661	677	3909
Canton, New York (C)	1011	632	906	1630	1394	1652	8020
Charleston, South Carolina (C)	236	86	207	236	173	207	1769
Charlotte, North Carolina (C)	(a)	280	426	(a)	482	541	3120
Chattanooga, Tennessee (A)	(a)	391	426	(a)	628	531	3118
Cheyenne, Wyoming (A)	595	1017	900	1479	1739	1745	7466
Chicago, Illinois (C)	670	608	696	1020	964	1098	6077
Cincinnati, Ohio (C)	536	456	615	768	794	869	4684
Cleveland, Ohio (A)	710	541	732	1119	1080	1125	6155
Columbia, Missouri (C)	512	576	651	851	886	911	4922
Columbia, South Carolina (C)	(a)	185	324	(a)	326	355	2364
Columbus, Ohio (C)	636	510	690	953	935	1003	5398
Concord, New Hampshire (A)	898	680	846	1559	1410	1498	7353
Concordia, Kansas (C)	485	711	693	823	1032	969	5315
Dallas, Texas (A)	200	318	303	315	385	303	2256
Davenport, Iowa (C)	670	681	795	1078	1088	1158	6289
Dayton, Ohio (A)	691	573	660	1109	1080	933	5264
Deer Lodge, Montana (C)	819	1026	1055	1916	2071	2187	8672**
Denver, Colorado (C)	525	787	759	952	1202	1259	5874
Des Moines, Iowa (C)	643	708	798	1055	1110	1155	6384
Detroit, Michigan (A)	782	580	777	1234	1116	1219	6490
Devils Lake, North Dakota (C)	931	1138	1179	1933	1838	2161	9970
Dodge City, Kansas (A)	442	761	672	790	1048	948	5035
Dubuque, Iowa (C)	729	735	846	1223	1215	1291	6790
Duluth, Minnesota (C)	972	973	1074	1845	1632	1970	9483
Eastport, Maine (C)	835	671	843	1499	1473	1662	8520**
Elkins, West Virginia (A)	760	603	741	1250	1244	1182	5697
El Paso, Texas (A)	277	512	381	416	616	421	2428
Ely, Nevada (A)	705	1036	(a)	1567	1911	(a)	(a)
Erie, Pennsylvania (C)	705	487	711	1071	977	1125	6273
Escanaba, Michigan (C)	907	802	960	1676	1478	1794	8771
Evansville, Indiana (A)	570	526	528	854	866	683	4244
Fort Smith, Arkansas (A)	384	444	408	582	614	470	3147
Fort Wayne, Indiana (A)	742	624	726	1223	1166	1073	5925
Fort Worth, Texas (A)	213	301	252	334	361	252	2148
Fresno, California (A)	236	364	315	379	446	334	2334
Galveston, Texas (C)	62	112	60	81	128	60	1016
Grand Junction, Colorado (A)	620	973	747	1084	1328	1116	5548
Grand Rapids, Michigan (C)	776	625	774	1226	1123	1250	6535
Green Bay, Wisconsin (C)	938	755	921	1644	1407	1558	7825
Greensboro, North Carolina (A)	114	302	492	166	330	635	3529
Greenville, South Carolina (A)	58	191	450	99	210	596	3380
Harrisburg, Pennsylvania (A)	650	504	660	967	957	989	5375
Hartford, Connecticut (A)	728	547	705	1117	1051	1097	6036
Hatteras, North Carolina (C)	(a)	89	234	(a)	210	234	2571
Havre, Montana (C)	662	915	1041	1561	1639	1931	8700
Helena, Montana (A)	754	939	948	1846	1840	1813	7894**
Houston, Texas (C)	87	152	114	119	175	114	1157
Huron, South Dakota (A)	733	949	1005	1451	1532	1654	8004
Indianapolis, Indiana (A)	682	610	687	1058	1089	985	5298
Jackson, Mississippi (A)	(a)	249	(a)	(a)	343	(a)	(a)
Kansas City, Missouri (A)	459	563	639	733	814	1866	4956
Knoxville, Tennessee (A)	(a)	395	519	(a)	656	702	3670
La Crosse, Wisconsin (A)	851	810	909	1474	1395	1467	7322
Lander, Wyoming (A)	672	1086	726	1662	1791	1656	7947

(a) Data not available.

[1]Figures in this column are normal totals for a complete heating season, September to June, incl.

Figures in this table, with seven exceptions, based on local weather bureau reports. Exceptions are Utica and Lewiston, figures for which are furnished through the courtesy of Coke Sales Department, Central New York Power Corp., Utica, N. Y., and Norman E. Ross, Bursar, Bates College, Lewiston, Me., respectively; Anaconda, Bozeman, Butte, Deer Lodge and Livingston, Mont., through the courtesy of the Montana Power Company.

[Table concluded on page 108]

Degree-Days for November, 1949 (Concluded)

(A) Airport readings (C) City office readings; (O) Readings at a point on outskirts of city.

HEATING AND VENTILATING's 22nd Year of Publication of Monthly Degree-Day Data

City	November			Cumulative, September 1 to November30			Heating Season[1]
	1949	1948	Normal	1948-49	1947-48	Normal	Normal
Lansing, Michigan (A)	871	633	861	1453	1251	1456	7048
Lewiston, Maine (O)	853	657	876	1478	1297	1546	7707
Lincoln, Nebraska (C)	546	756	753	936	1131	1069	5999
Little Rock, Arkansas (A)	338	387	381	480	538	428	2811
Livingston, Montana (C)	535	948	864	1479	1576	1614	7245**
Los Angeles, California (C)	66	101	123	120	143	123	1504
Louisville, Kentucky (A)	558	480	552	803	813	738	4180
Lynchburg, Virginia (A)	523	428	537	750	794	757	3980
Macon, Georgia (C)	.....	226	324	.....	372	330	2201
Madison, Wisconsin (C)	801	756	891	1344	1276	1437	7429
Marquette, Michigan (C)	951	832	960	1682	1517	1752	8693*
Memphis, Tennessee (A)	(a)	379	402	(a)	569	464	2950
Meridian, Mississippi (C)	(a)	261	312	(a)	382	334	2160
Milwaukee, Wisconsin (A)	801	704	846	1361	1237	1380	7245
Minneapolis, Minnesota (A)	836	897	963	1423	1383	1537	7850
Montgomery, Alabama (C)	(a)	207	273	(a)	284	273	1884
Nantucket, Massachusetts (A)	597	483	609	986	970	1007	5957
Nashville, Tennessee (A)	(a)	425	483	(a)	671	619	3507
New Haven, Connecticut (A)	672	513	693	1021	933	1092	5895
New Orleans, Louisiana (C)	135	102	102	145	223	102	1024
New York, N. Y. (C)	552	380	594	728	689	916	5274***
Nome, Alaska† (A)	988	1219	1509	1541	2046	3379	14580**
Norfolk, Virginia (C)	363	227	411	418	402	510	3350
North Head, Washington (C)	356	599	510	1008	1193	1131	5452**
North Platte, Nebraska (A)	599	861	837	1207	1326	1313	6366
Oakland, California (A)	246	349	330	505	616	603	3143**
Oklahoma City, Oklahoma (C)	305	490	459	514	610	564	3613
Omaha, Nebraska (A)	591	752	780	1008	1130	1109	6131
Oswego, New York (C)	810	536	783	1263	1146	1356	7088
Parkersburg, W. Virginia (C)	594	474	624	893	914	909	4775
Peoria, Illinois (A)	682	664	789	1116	1101	1173	6109
Philadelphia, Pennsylvania (C)	705	665	544	705	665	815	4737***
Phoenix, Arizona (C)	30	242	156	79	256	156	1405
Pittsburgh, Pennsylvania (C)	621	462	669	933	920	982	5235
Pocatello, Idaho (A)	677	935	813	1504	1618	1468	6655
Portland, Maine (A)	862	676	807	1520	1362	1446	7218
Portland, Oregon (C)	369	593	558	860	1021	995	4469
Providence, Rhode Island (C)	644	458	693	975	877	1104	6015
Pueblo, Colorado (A)	530	831	741	991	1264	1135	5514
Raleigh, North Carolina (C)	(a)	264	429	(a)	487	559	3234
Rapid City, South Dakota (A)	569	926	870	1307	1450	1529	7118
Reading, Pennsylvania (C)	622	439	669	881	819	1013	5389
Red Bluff, California (A)	209	358	(a)	323	443	(a)	(a)
Reno, Nevada (A)	619	806	714	1292	1407	1311	5892
Richmond, Virginia (C)	483	326	456	574	594	617	3695
Rochester, New York (A)	822	564	786	1346	1172	1289	6732
Roseburg, Oregon (C)	397	600	561	891	1048	1022	4428
Roswell, New Mexico (A)	374	616	516	643	855	702	3484
Sacramento, California (C)	238	347	351	373	464	422	2653
St. Joseph, Missouri (A)	541	633	633	880	967	881	5161
St. Louis, Missouri (C)	480	499	597	725	758	802	4585
Salt Lake City, Utah (A)	624	891	723	1202	1357	1129	5555
San Antonia, Texas (A)	105	241	126	145	273	126	1202
San Diego, California (A)	80	152	165	141	208	199	1645
Sandusky, Ohio (C)	675	545	726	994	1026	1079	6208
San Francisco, California (C)	161	256	261	485	568	521	3264**
Sault Ste. Marie, Michigan (A)	1050	827	978	1912	1642	1877	9285**
Savannah, Georgia (A)	(a)	88	201	(a)	166	201	1490
Scranton, Pennsylvania (C)	740	520	732	1165	1053	1189	6129
Seattle, Washington (C)	405	602	570	950	1172	1150	4934**
Sheridan, Wyoming (A)	585	980	978	1514	1607	1878	8008
Shreveport, Louisana (A)	241	301	270	331	372	270	1938
Sioux City, Iowa (A)	679	871	870	1217	1340	1318	6898
Spokane, Washington (A)	713	909	819	1512	1696	1526	6355
Springfield, Illinois (C)	572	576	681	884	893	963	5373
Springfield, Missouri (A)	530	567	564	868	871	781	4428
Syracuse, New York (A)	809	551	798	1286	1186	1319	6893
Tacoma, Washington (C)	421	638	588	1054	1302	1195	5181**
Terre Haute, Indiana (A)	662	590	615	1020	1026	615	4872
Toledo, Ohio (A)	755	605	732	1221	1177	1110	6077
Topeka, Kansas (C)	478	589	639	765	841	875	4969
Trenton, New Jersey (C)	622	417	588	873	786	830	4933
Utica, New York (O)	847	519	781	1224	1050	1393	6796
Valentine, Nebraska (C)	624	909	897	1336	1467	1480	7039
Walla Walla, Washington (C)	518	627	651	1025	1159	1013	4808
Washington, D. C. (C)	502	389	594	673	699	845	4626
Wichita, Kansas (A)	426	630	636	703	834	828	4673
Williston, North Dakota (C)	728	1008	1137	1787	1699	2067	9323
Winnemucca, Nevad (C)	638	889	810	1395	1496	1509	6427**
Yakima, Washington (A)	(a)	809	780	(a)	1482	1337	5599

(a) Data not available.
†Nome data are for October.

*Includes August.
**Includes July and August.
***New 48-year normal covering 1898 to 1946.

[1]Figures in this column are normal totals for a complete heating season, September to June, incl.

15-STORY APARTMENT BUILDING HEATED BY REVERE COPPER RADIANT HEATING COILS EMBEDDED IN CONCRETE FLOORS

1350 Astor Street, Chicago. Ralph C. Harris, Architect; Bueter & Wolff, Engineering Consultants; Gallaher & Speck, Inc., Heating Contractors; The Davies Supply Company, Revere Distributor.

ACCORDING to recent building reports, the "Gold Coast" in Chicago has been chosen for the location of several very fine, new apartment buildings. Among them is 1350 Astor Street.

One of the interesting features of this outstanding building is that apartments on all fifteen floors will have the comfort and convenience of radiant panel heating. The heating coils are imbedded in the concrete floors. They utilize over 52,000 feet of Revere Copper Water Tube . . . nearly two-thirds of a mile of tube per floor.

From the beginning of the installation throughout a lifetime of service, Revere Copper Water Tube is ideal for radiant panel heating. Long lengths of this lightweight, easy-to-bend tube—the joints made with solder-type fittings—reduce the time and cost of installation. And experience has clearly proven that you can rely on this tube for long years of trouble-free service.

All Revere Copper Water Tube is stamped at regular intervals with the Revere name and the type as your assurance of top quality.

Revere materials including Copper Water Tube and Red-Brass Pipe—are available through leading distributors in all parts of the country. The Revere Technical Advisory Service is always ready to serve you. Call your Revere Distributor.

REVERE

COPPER AND BRASS INCORPORATED

Founded by Paul Revere in 1801

230 Park Avenue, New York 17, New York

• • •

Mills: Baltimore, Md.; Chicago, Ill.; Detroit, Mich.; Los Angeles and Riverside, Calif.; New Bedford, Mass.; Rome, N. Y.
Sales Offices in Principal Cities, Distributors Everywhere.

NEWS OF THE MONTH

CONSTRUCTION OUTLOOK

for 1950 continues optimistic with support of public funds.

The outlook is for another record year for construction in 1950, in terms of the dollar volume of new construction to be put in place. Indications are that the overall total of private and public expenditures for new construction will equal the probable 1949 total of $19¼ billion, according to joint estimates of the Departments of Commerce and Labor. Private construction outlays in 1950 probably will drop about $925 million from the total for 1949, but public construction expenditures are expected to increase by a like amount.

Measured in terms of physical (as contrasted with dollar) volume, total new construction in 1950 is also expected to be on a par with that of 1949. Construction costs are expected to show a slight upward tendency in 1950 but the average for the year probably will be about the same as the average for 1949. During the year 1949, the Department of Commerce Composite Index of Construction Costs declined gradually from 211.3 (1939 = 100) in January to a low point of 205.1 in August. It turned upward slightly in September and October and it appears likely that further small advances will be registered during final tabulation of figures for 1949.

Requirements for some materials such as lumber and paint may be slightly lower in 1950 than in 1949, but other materials, such as cement and reinforcing steel, probably will be in somewhat greater demand, giving support to current price levels for materials. Existing wage rates for construction workers also will tend to be sustained by anticipated full employment in the construction industry in 1950.

• **PRIVATE.**—The total value of private construction to be put in place in 1950 probably will be about $13.1 billion, nearly 7% less than the anticipated total for 1949 of just over $14 billion. Declines are expected in 1950 in all major classes of private construction —residential building, nonresidential building, farm construction, and public utility construction.

A slackening of the recent unprecedented pace in new nonfarm homebuilding is foreseen for 1950. As a result of the boom in new dwelling units started since mid-year, a total of nearly 1,000,000 new units now appears to be probable for 1949, shattering all previous records. The largest number of starts in any year prior to 1949 was the 1925 record of 937,000 units, a record almost equalled in 1948 when 931,300 new nonfarm dwelling units were placed under construction. The 1950 total is expected to drop to about 900,000 units.

Out of the total of nearly 1,000,000 new dwelling units started in 1949, it is estimated that private financing will account for about 960,000, and the value of private nonfarm residential construction put in place will total about $7.0 billion this year. In 1950, the number of privately-financed new dwelling units started is expected to be down to about 830,000 and the value of private residential construction put in place will drop to around $6.5 billion.

The outlook is for a decrease of about 7% in 1950 in the total value of private nonresidential building to be put in place. Industrial construction probably will drop about 26% from the 1949 total, continuing the downtrend that has been so marked during 1949, as immediate postwar expansion plans were completed. Construction of new churches and of social and recreational facilities also is expected to decline in 1950 from the high levels of 1948 and 1949.

Building of new commercial structures, especially stores, has been lagging behind the rate that the need for additional commercial space would appear to justify. With it becoming apparent that substantial reductions in construction costs are not to be expected in the immediate future, some of the postponed construction of commercial facilities should get under way in 1950, particularly in the building of shopping centers for newly developed residential areas. The value of new commercial construction is expected, therefore, to show a small increase over the 1949 total.

Private educational building probably will continue at about the 1949 rate in response to the demand for additional facilities. A substantial increase in hospital and institutional building seems assured under the National Hospital Program.

Farm construction probably will continue to ease off, following the trend of farm income.

Railroads and telephone and telegraph companies are believed to have passed the peak of their immediate postwar construction programs and are expected to spend less money for new construction in 1950 than they spent in 1949. Electric light and power companies, likewise, probably will begin to curtail their new construction outlays. Gas companies, on the other hand, indicate intentions of increasing construction expenditures in 1950 above 1949 amounts.

• **PUBLIC.**—The total value of all types of public construction to be put in place in 1950 is expected to exceed $6.1 billion, an increase of nearly 18% over the probable $5.2 billion total for 1949. Expenditures for all types of public construction probably will be larger in 1950, except for military and naval facilities.

Public housing probably will show the largest increase percentagewise, as a result of activities under the Housing Act of 1949. The value of new residential building put in place is expected to rise from about $220 million in 1949 to around $400 million in 1950, an increase of approximately 82%. The 1949 total of new public housing units started is expected to reach about 40,000, most of which are under State and local programs. In 1950, Public Housing Authorities probably will start between 60,000 and 80,000 units.

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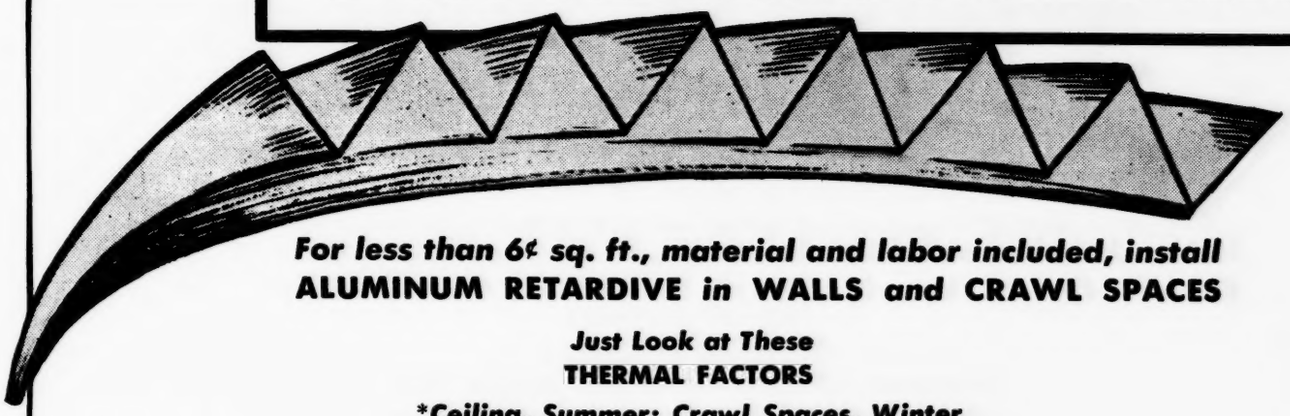
is the economical insulation



For less than 6¢ sq. ft., material and labor included, install
ALUMINUM RETARDIVE *in* WALLS *and* CRAWL SPACES

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THERMAL FACTORS

****Ceiling, Summer; Crawl Spaces, Winter***

***DOWN HEAT**	**C .097 = 3⅖" Dry Rockwool**
WALL HEAT	**C .148 = 2⅕" Dry Rockwool**
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Vapor Permeability is ZERO

Retardive throws back 97% of the RADIATED HEAT which strikes it; completely blocks CONVECTION. Absolutely impervious to water vapor and other gases, including hot and cold air. A FIRE STOP, because it is heavy metal and nothing else, and is practically NON-EMISSIVE (will therefore bar secondary ignition of objects on the side away from a fire.)

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There is substantial heat loss from walls behind radiators, especially if recessed. Heat by Conduction, Convection, and especially Radiation, hits the wall, flows through it, and is dissipated outside. Retardive, installed with proper air space behind a radiator, reflects back INTO THE ROOM a large amount of the otherwise wasted heat.

IN WARM CLIMATES

In warm climates and tropic regions, Retardive is the economical insulation for attics and walls. Mold, vermin and termite proof, it also bars water vapor, moisture and heat.

UNDER FLOORS AND IN CRAWL SPACES

Retardive prevents heat loss through floors and crawl spaces and creates foot comfort. Otherwise, invisible heat rays, which have no temperature, following nature's law that warm flows to cold in Radiation, will flow from warm ceilings and walls to cold floors and be dissipated to the earth below.

EXTRA TOUGH

Retardive, .002" thick, has a bursting strength of 52 lbs. per sq. in. (Mullen test), compared with a bursting strength of 3 lbs. for ordinary foil. It can be used in spaces as shallow as ½", and is made for 8", 16", and 24" centers. Compactly packaged in 375 ft. lengths.

USE COUPON FOR YOUR FREE COPY of National Bureau of Standards tests with aluminum insulation in CRAWL SPACES, for heat and vapor flow and condensation, reported by Technical Division of National Housing Agency in Technical Bulletin No. 38.

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Please send "N.H.A., Nat. Bur. Standards, Technical Bulletin No. 38." HV

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Continued pressure for additional school facilities to take care of record enrollments should result in a further rise in public expenditures for educational buildings to about $900 million in 1950. The value of work put in place on veterans' hospitals and on publicly-sponsored hospitals under the National Hospital Program is expected to increase by about 27% to a total of around $575 million in 1950.

Highway construction will advance about 15% in dollar volume to reach $1.9 billion in 1950, judging from recent State and local actions to obtain additional highway funds through increases in gasoline taxes and through bond issues. Municipalities will expand construction of sewer and water facilities and of municipally-owned utilities to serve growing communities. A 20% increase in conservation and development work is also indicated by the federal budget for river, harbor, flood control and reclamation projects.

• **PENDING REVISIONS.** — Data covering estimated value of various types of new construction put in place in 1949 and to be put in place in 1950 do not include additional allowances for certain contemplated revisions of the present construction activity series. When these revisions are completed, the totals for both 1949 and 1950 probably will be revised upward by as much as $3 billion to $4 billion.

Published estimates of farm construction will be increased substantially from 1946 onward on the basis of new information available from recent surveys made by the Bureau of Agricultural Economics. The private nonfarm residential building estimate will be revised to include the value of major additions and alterations, land improvement costs, engineering and architectural fees, and operative builders' margins. The private nonresidential building and public utility construction estimates will be increased to include several missing minor segments, and certain costs incurred prior to the start of actual construction operations.

The estimates of public construction expenditures will be revised upward to include previously unavailable data on the value of work done on atomic energy projects from 1943 onward. Certain costs preliminary to new construction will also be added to the estimates of value of public construction.

COAL RATIONING

begins in Midwest as dealers in Illinois and Indiana cut deliveries.

An unexpectedly sudden crisis in the nation's coal supplies brought the executive committee of the American Retail Coal Association to Chicago for an emergency meeting December 14.

• **TWO WEEKS.**—J. Atlee Schaefer of Cleveland, president of the association, predicted that whole cities and towns in the Midwest might be running out of coal in two weeks if current restrictions on coal production were not relaxed.

Chicago's coal users, previously relatively unconcerned about the shortage, felt it sharply after a December cold snap. Many dealers here—and the majority in Northern Indiana—were rationing coal in quantities of as little as one ton for every ten ordered.

Most Gary and Hammond, Ind., coal dealers reported they were rationing their supplies right down to the one-tenth-of-an-order delivery.

• **WHY.**—The three-day maximum work week was decreed by John L. Lewis on Dec. 5 at the end of a temporary armistice between the United Mine Workers and the coal operators.

The present acute shortage is due to the fact that Mr. Lewis' order applies not only to actual mining, but to all mine operations. For every three days' preparatory work in a strip mine, Mr. Schaefer said, enough coal is uncovered for only one day's actual mining.

B. E. Ehrheim, secretary of the association, pointed out that this was only a third of production during the three-day work week last summer, when stripping operations could be carried on as long as necessary to uncover a three-day supply of coal.

ATOMIC HEAT

nears practical application as new transfer agents are developed.

Important progress has been made in the development of suitable substances for transferring and harnessing the enormous quantities of heat generated in a nuclear reactor (atomic furnace), it was revealed in Chicago December 12 by David E. Lilienthal, retiring chairman of the United States Atomic Energy Commission, at the first press conference held by the commission outside of Washington.

The occasion was a meeting of members of the AEC with managers of its seven major field offices and directors of eleven research centers of the national atomic energy program at the Argonne National Laboratory, near Lemont, Ill., twenty-five miles from Chicago. The meeting lasted three days.

Participating in the press conference, besides Mr. Lilienthal, were Commissioners Sumner T. Pike, Dr. Henry D. Smyth and Gordon Dean; Carroll L. Wilson, general manager of the AEC; Dr. Lawrence R. Hafstad, director of reactor development; Dr. Shields Warren, director of biology and medicine; Dr. Walter H. Zinn, director of the Argonne laboratory (operated by the University of Chicago), and Alfonso Tammaro, AEC manager of operations for the Chicago area.

One of the major problems that must be solved before nuclear energy can be harnessed for peacetime industrial power uses is the development of what is known as a heat exchanger, or a heat transfer agent, that would carry away the heat generated in the nuclear reactor to a suitable engine, such as a turbine, which would translate the heat into useful power.

• **AGENT.**—Such a heat transfer agent must fulfil a number of demands peculiar to nuclear energy, which make the common heat exchangers, such as steam, unsuitable. One of the basic demands is for a substance that does not absorb neutrons, without which the

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. . . the completely adjustable Air Diffusers, specified by Western Union for big, high speed communications center at Philadelphia

These Kno-Draft features insure satisfaction.

Fig. 1.

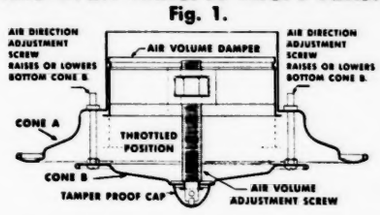
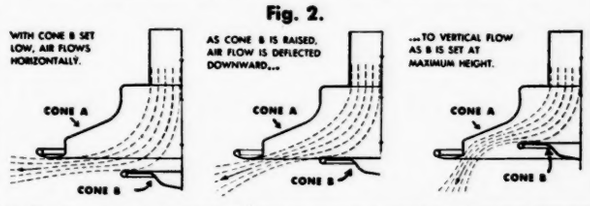

AIR DIRECTION ADJUSTMENT SCREW RAISES OR LOWERS BOTTOM CONE B.
AIR VOLUME DAMPER
AIR DIRECTION ADJUSTMENT SCREW RAISES OR LOWERS BOTTOM CONE B.
CONE A
THROTTLED POSITION
CONE B
TAMPER PROOF CAP
AIR VOLUME ADJUSTMENT SCREW

Fig. 1. Type D Air Volume Control consists of a cylindrical, sliding, sleeve-type damper, connected by a specially designed spider to a centrally operated screw. It varies only the quantity, not the characteristics, of the air distribution. Fig. 2. Any angle of air discharge can be obtained by raising or lowering bottom Cone B.

Fig. 2.


WITH CONE B SET LOW, AIR FLOWS HORIZONTALLY.
CONE A
CONE B
AS CONE B IS RAISED, AIR FLOW IS DEFLECTED DOWNWARD...
CONE A
CONE B
...TO VERTICAL FLOW AS B IS SET AT MAXIMUM HEIGHT.
CONE A
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nuclear fire would go out just as an ordinary fire would be extinguished when the oxygen supply was cut off. The neutrons are the fundamental atomic particles, released in the course of atom-splitting, which are essential for the maintenance of the chain reaction—namely, the splitting of further atoms.

A suitable heat exchanger for use in the development of industrial atomic power must also be able to transfer heat at high temperatures, since only nuclear reactors operating at high temperatures can produce energy that can be utilized efficiently. The nuclear reactors now in operation at Hanford, Wash., designed primarily for the production of plutonium, operate at relatively low energy and give off waste heat that raises the temperature of the Columbia River a few degrees.

• **NEARER.**—While neither Mr. Lilienthal, nor his colleagues, would say whether the problem of developing a suitable heat exchanger had been fully solved, they intimated that it was well on the way to solution, thus marking a new major landmark toward the utilization of the vast energy released in the splitting (fission) of atoms of uranium 235 or plutonium for peacetime industrial uses.

One kilogram of either U-235 or plutonium, the two active elements in the atomic bomb, releases 25,000,000 kilowatt-hours of energy, equivalent to the operation of Grand Coulee Dam at full capacity for twelve and a half hours.

However, Mr. Lilienthal cautioned, while experimental nuclear power reactors might be in operation within two years or so, we were still a long way from large-scale industrial operation, which might still be twenty or thirty years off. He added that the heads of this country's large utility companies were doing their best to cooperate with the AEC in every way possible to speed the realization of the dream to utilize the atom for peacetime power.

While the development of the use of nuclear power was necessarily slow, involving the solution of a large number of difficult problems, the "widespread use of radio-active isotopes as research tools is way ahead of what I believed possible." Mr. Lilienthal said.

In answer to a question whether the work on nuclear power reactions would progress faster if more funds were available, Mr. Lilienthal said that "the problem of progress was not so much a matter of money but how to attract the talent." Increased appropriations would do no good, he stressed, if the conditions for attracting talent to the work were not favorable.

It was announced today that fifty-seven declassified and unclassified reports had been issued by AEC laboratories in November. Among these were reports on the effect of low dosages of radiation upon the blood count of exposed atomic energy workers; a novel method for detecting leaks in industrial chemical processing systems, a low-cost production method for industrial fluorine, and redeterminations of two basic properties of carbon.

Information about these reports may be had from the Document Sales Agency, Atomic Energy Commission, Box E, Oak Ridge, Tenn.

LONGEST PIPE LINE

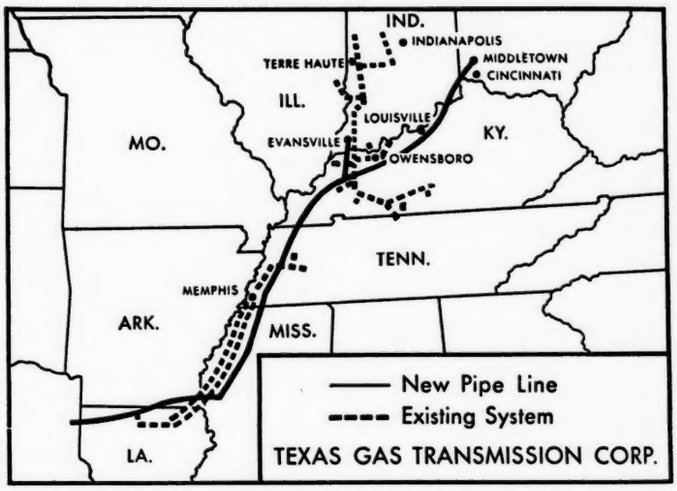
built in 1949 will bring natural gas to nine states.

The country's newest long-distance pipe line went into operation December 22 as Louisville Gas and Electric Co. received the first delivery of natural gas from southwest gas fields through the new 26-inch line of Texas Gas Transmission Corp.

• **CAPACITY.**—The new transmission line, built in less than eight months, is the longest constructed and put into operation during 1949. It will have an initial capacity of 304,000,000 cu ft a day when completed in Middletown, Ohio, in January. This will be increased in 1950 to 400,000,000 cu ft a day.

Deliveries will start to other utilities along the line, and to Texas Eastern Transmission Corp. for transmittal to subsidiaries of the Columbia Gas System and Consolidated Natural Gas Corp., and to other northeastern utilities.

• **RANGE.**—The new line, built at an approximate cost of $73 million, brings additional supplies of natural gas



to utility customers in Tennessee, Kentucky, Illinois, Mississippi, Louisiana, and Arkansas in time to meet peak winter heating needs.

• **SERVICE.**—Other utilities will benefit by the start of operations of the new gas artery. Existing customers of Texas Gas serving more than 115 large and small communities will receive approximately 120,000,000 cu ft a day more than their present supplies.

When the new line is completed later in January to Middletown, Ohio, Texas Gas will be ready to deliver to Texas Eastern initial minimum quantities of 123,000,000 cu ft a day, which will be increased by the addition of compressor horsepower to 235,000,000 a day by mid-1950. Texas Eastern will sell this amount through a new loop line in Ohio to companies serving Akron, Canton, Cleveland, Youngstown, and numerous other communities in Ohio, Pennsylvania and West Virginia.

Ten compressor stations with a total of 68,800 horsepower will push gas through the new line.

With completion of the new 800-mile line from Carthage to Middletown and addition of compressor horsepower, Texas Gas will have by the middle of 1950 a pipe line system totaling 2,400 miles of pipe with total capacity of over 650,000,000 cu ft of gas a day.

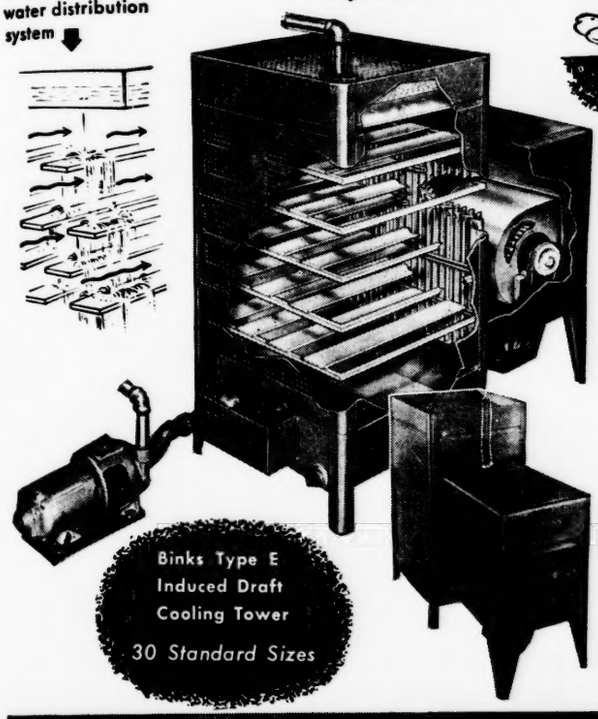
Diagram showing new nozzleless water distribution system

Quiet...

a NEW type cooling tower

for use with "packaged" water-cooled air conditioning and refrigeration systems

A new type of water distribution system eliminates the use of spray nozzles in Binks Type E blower-type cooling towers. Distinguished by extremely quiet operation and high efficiency, these towers are ideal for use with "packaged," water-cooled air conditioning and refrigeration condensing units, such as are installed in small businesses and residences. Installations may be either outdoors or indoors.



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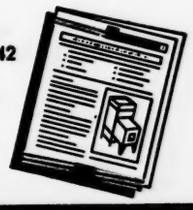

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BRICK-SET TUBULAR HEATER

For use with central heating system (with duct distribution). Single heater capacities, 2,800,000 to 8,000,000 Btu per hour. Battery of two, operating as unit, provide over 10,000,000 Btu per hour.

Brick Set Tubular Heater

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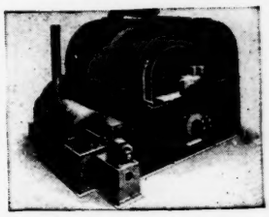
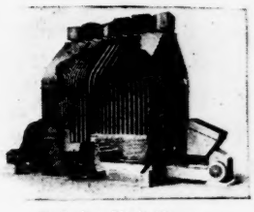
For use with central heating system (with duct distribution). Capacity range, 2,000,000 to 6,000,000 Btu per hour. May be installed in heated area without enclosure, requires no foundation. Unit may be moved by taking apart and reassembling.



Steel Encased Tubular Heater

TUBULAR UNIT HEATER

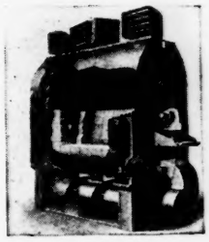
For use as central system (with duct distribution) or as unit heater, with adjustable outlet nozzles. Capacity range, 2,000,000 to 6,000,000 Btu per hour. In sizes up to 4,000,000 Btu, shipped completely assembled with all but mechanical equipment, refractory lining and controls in place. Requires no foundation. Equipped with crane hooks for moving.



Tubular Unit Heater

SHELL UNIT HEATER

For use with or without distributing duct system. Capacity range, 300,000 to 2,000,000 Btu per hour. Both hand- and stoker-fired models. All units shipped completely assembled, wired, ready for operation. Units furnished with either refractory lined or stainless steel combustion chambers. Heaters may be floor mounted or suspended in any position.



Shell Unit Heater

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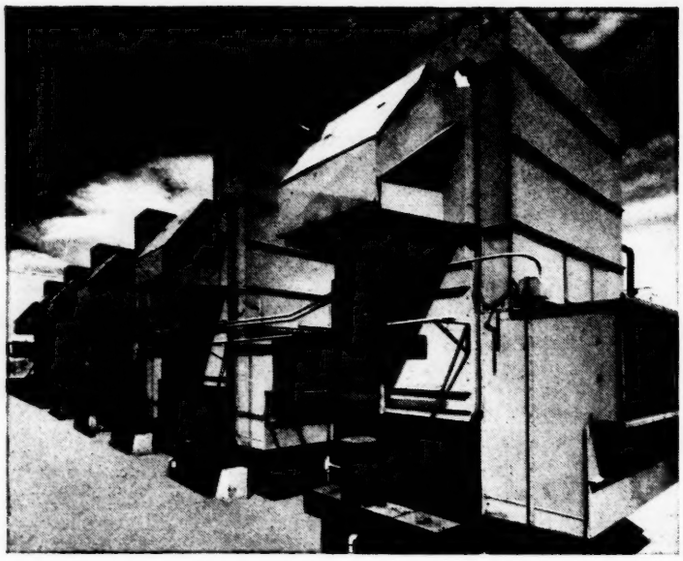

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In this new method the refrigerant gas passes through two cooling coils. The first coil, air-cooled, removes the superheat and condenses oil vapor from the refrigerant; the second condenses the refrigerant by the evaporation of a water spray from its surface. The heat is transferred to the air; less than 10% of the water used in conventional condensers is consumed and you save the cost of the water and the cost of its piping, pumping and disposal.

In addition the Niagara Aeropass Condenser controls the head pressure of your compressors at the lowest point for good operation, reducing your power bills. It does this automatically the year 'round, giving full capacity for peak summer loads and providing the greatest power saving in cold weather.

Hundreds of experiences in all industries that use refrigeration demonstrate these benefits and prove that they give a lasting improvement in refrigeration plant operation.

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BUILDING RESEARCH

objectives set forth in statement by executive director of BRAB.

Plans for the initial activities of the Building Research Advisory Board, recenty set up in the National Research Council, were announced by William H. Scheick, the newly appointed executive director. BRAB was established at the request of the building industry to serve as a clearing house of information about building research, wherever conducted, and to stimulate additional research into promising but neglected fields of interest to the building industry.

• **PROJECTS.**—Mr. Scheick listed six specific projects to be started immediately:

(1) A survey to develop a list of urgent problems of the building industry susceptible to solution by research. This information will be sought by a canvass of research agencies, trade and professional organizations, and technical and research personnel in the industry.

(2) A series of research correlation conferences to bring together those actively engaged in research along specific lines in order to explore and evaluate subjects, review accomplishments, and chart future action.

(3) Initiation of a detailed analysis of "master outline" of building research and related fields to clarify the present picture of building research. This will necessarily be a long-term project.

(4) Encouragement of government agencies concerned with building research to avail themselves of the advisory services of BRAB.

(5) Cooperation with builders' and contractors' associations to promote field tests and demonstrations of research results as a method of speeding up the practical application of technological advances.

(6) Development of an effective program of publication and information.

• **FIVE YEARS.**—All of these activities will be carried on simultaneously. They will form the basis of a five-year program which will be expanded further as additional funds and personnel become aavailable.

The Building Research Advisory Board is in the Division of Engineering and Industrial Research of the National Research Council. The Council is the operating arm of the National Academy of Sciences, a non-governmental scientific organization.

HEATING SURVEY

shows Iowa home owners want new equipment.

A substantial market in Iowa for heating equipment is indicated by a state-wide survey recently completed by The Des Moines Register and Tribune research department.

The survey shows that only four out of ten Iowa families now have heating equipment which was manufactured since the end of the war. The survey indicates that about 70,000 home owners, or one in ten, say that their heating equipment needs repair or replacement and that this same number of families plan to buy some heating equipment during the next 12

months. Of these, more than 40% said they intended to purchase an entirely new heating plant.

• **SHIFT.**—Comparison of this study with a similar one made in 1947 shows a substantial shift from the use of coal to the use of oil and gas as a fuel for heating homes. Three-fourths of the coal users still shovel their coal, indicating that about 315,000 Iowa home owners are potential buyers of stokers. Four out of ten families, or about 280,000, say that they do not now have automatic or thermostatic heating controls but would like to have them.

• **BRANDS.**—The survey points out the importance of dealer names and brand names. Only one-third of the families surveyed were able to give the name of the dealer they would go to if they wanted to buy some heating equipment. Well-advertised brands of different categories of heating equipment were remembered much more frequently, the striking example being in theromstatic controls, where one widely advertised brand was remembered by 57% of all Iowa home owners, the next best-remembered brand being recalled by only six per cent.

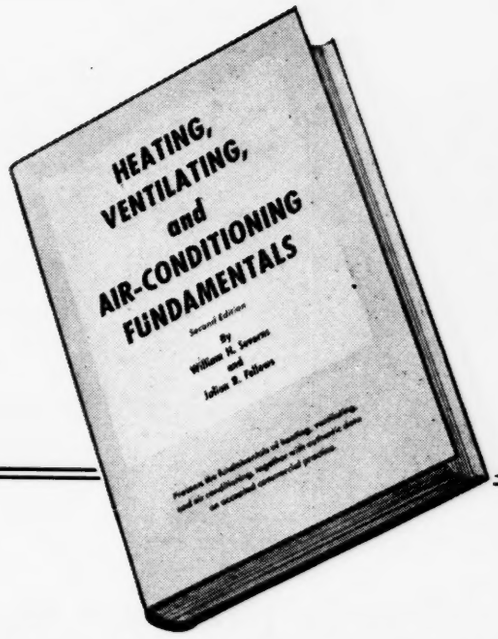
Charles Feldmann, Register and Tribune national advertising manager, says that the survey was undertaken as a service to heating equipment dealers and distributors serving the Iowa market and to heating equipment manufacturers.

• The first meeting of the Radiant Heating Institute was held recently at the Biltmore Hotel in Los Angeles. Thirty-four representatives of radiant heating engineers, installers, manufacturers, suppliers and public utilities were present to hear their newly elected president, A. L. Ottum, vice president, Horace Allison, and secretary-treasurer, George Turner, state that the purpose for which the organization was founded is to promote recognition as an industry and to present to architects, engineers, builders, allied trades and the general public unbiased findings and facts of the continuous growing uses and applications of radiant heating.

• Scovill Manufacturing Co. has begun operation of its new continuous strip mill built at a cost of over $10 million. The mill features the casting of brass bars in a continuous flat metal casting machine, the processing of which stems from Scovill research and experiment. From 1-ton bars so made, the great mills and handling devices produce sheet and strip brass of a quality, uniformity, and economy of use for manufacturing not heretofore available.

RADIANT HEATING FOR BROODER HOUSES

In the article "Radiant Heating for Chicken Brooder Houses," by T. Napier Adlam, in the November issue of HEATING AND VENTILATING, credit was inadvertently omitted to Page-Hersey Tubes, Ltd., Toronto, Canada, who furnished the photographs for Figs. 2 to 5 inclusive. The author and editors are glad to acknowledge the cooperation of Page-Hersey Tubes, Ltd.



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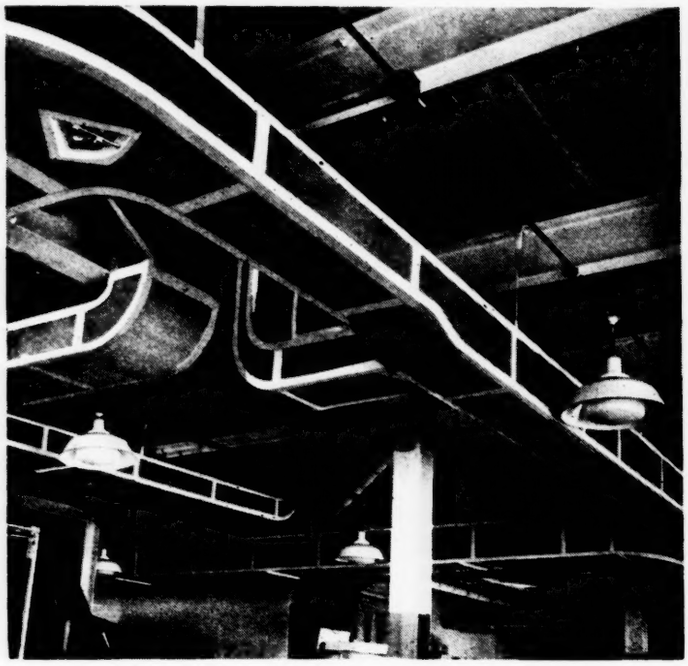

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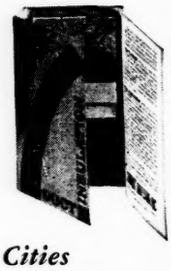

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Jet Laboratory Nears Completion

(Concluded from page 95)

test chambers. Each can be used for testing burner components or entire engines. All four of the high-ceilinged thick-walled test chambers are served by a maze of pipes and tubes neatly brought into the cells under a grating floor. The service pipes feed hot or cold, dense or thin air into the engines and the engine parts to simulate flight conditions in varied altitudes and temperatures. The air can be cooled to minus 70 degrees and thinned to an equivalent of that found at the cold reaches of 40,000 feet.

To provide the tremendous power demanded by the jet tests, the central service equipment section of the laboratory has enough marine power plants to move a formidable fleet. The four brand-new boilers built for the navy cruisers stand in line on the service floor near four of the turbo-generators from the war surplus destroyer escorts. Each of the four generators turn out 4,600 kilowatts each, a total of 18,400 kilowatts—enough to supply a city of 70,000 with light and power.

Through a steel pipe six feet in diameter and 190 feet long, the laboratory will take in 120,000 gallons of water a minute from the Connecticut River. The rate of flow is nine times greater than the normal consumption of Hartford. Warmed, but otherwise unchanged by its brief part in jet engine testing, the water will cascade back into the river through a concrete sluiceway. A 94-foot-high pump house at the river's edge will circulate the water.

The air used in the engines and engine parts has the noise strained out of it before it is sent outside the building. The exhaust gases pass through one of three underground silencing chambers. They are built of heavy concrete faced with a sound absorbing material. More of the remaining jet sound is lost in a labyrinth before the gas is passed into the outer air through slots set in concrete bunkers. The solid blank walls of the building were also designed to hold in the noises.

Boards of compressed glass fibers are used for silencing the air taken in and out of the building for ventilation. The vertical boards form a series of baffles which are set in the intake and exhaust labyrinths on the laboratory's roof.

At the south side of the laboratory is a tank farm with three tanks of 1,090 barrels each for jet fuels and five tanks of 18,000 barrels each to supply the heavy crude oil for the boiler fires of the entire Pratt & Whitney Aircraft plant. From the tanks a supply line runs to a river dock where seagoing barges can unload 17,000 barrels at a time into the fuel tanks.

Albert Kahn Associated Architects and Engineers, of Detroit, was architect for the project; Burns & Roe, Inc., of New York, was engineering consultant, and the Turner Construction Company, of New York and Boston, was the contractor.

NEW CATALOGS

Tempered Industrial Ventilation

Year 'round mechanical ventilation of industrial structures to remove contaminated air is described in an illustrated brochure. Bulletin 520 shows how foundries and other types of industries may be ventilated and tempered make-up air introduced.—*Heating Section, Dravo Corp., Pittsburgh 22, Pa.*

Item 1

Baseboard Radiation

Dunham baseboard radiation is described in bulletin No. 639D, first of a 1950 series describing all types of Dunham heating equipment. Ratings and engineering data for sizing and piping design are included with photographs of actual installations in residences, institutions and commercial buildings.—*C. A. Dunham Co., 400 W. Madison Street, Chicago 6, Ill.*

Item 2

General Controls

A 100-page catalog, No. 53G, describes and illustrates automatic pressure, temperature, level, and flow controls. Dimensional drawings and tables of application data and prices are included. Catalog is fully indexed. Line includes thermostats, clocks, gas controls and valves, electric transformers and switches, magnetic valves, refrigeration controls, and industrial motor valves.—*General Controls Co., 801 Allen Ave., Glendale 1, Calif.*

Item 3

Condensing Units

Servel Supermetic and belt-driven condensing units are described in a 40-page, 2-color catalog with complete specification data for commercial electric refrigeration and air conditioning applications.—*Servel Inc., Evansville 20, Ind.*

Item 4

Pipe Fittings

B & G Monoflo pipe fittings, both iron and copper, are described and illustrated in a 6-page, 2-color bulletin No. CL-949. Included is a simplified design table for designing a small Monoflo system.—*Bell & Gossett Co., 8200 N. Austin Ave., Morton Grove, Ill.*

Item 5

Boiler-Stoker Combinations

Bulletin SF-1 describes Brownell Unitbilt boiler-stoker combinations in capacities from 2,190 to 8,500 sq ft of steam radiation. Specification tables are included.—*The Brownell Co., 410 N. Findlay St., Dayton 1, Ohio.*

Item 6

CAUTION

TO VENTILATOR BUYERS

If you want to *be sure* of what you're getting when you buy ventilators, insist on *certified* capacity ratings based on tests made with wind blowing in *all* directions, as indicated below.

Only such tests can guarantee the capacities a ventilator will deliver under actual operating conditions! Don't be misled into buying on size alone. Insist on the correct size for the capacity required.

The Breidert Air-X-Hauster has been tested by Smith, Emery & Co. of San Francisco, Pacific Coast branch of the Pittsburgh Testing Laboratory, with wind directed at *all* angles shown above. It is the *only* ventilator on the market with published certified ratings based on such tests. Breiderts are extensively used on industrial, commercial and residential buildings all over the country, and on most types of pleasure craft and ships.

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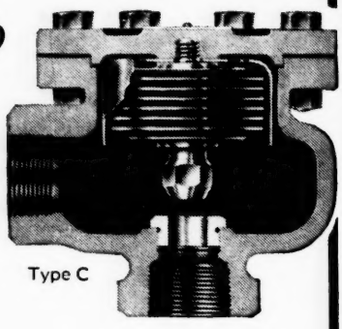

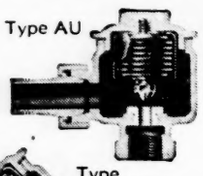

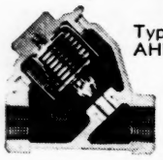

Records of a recent installation of Nicholson steam traps, by a leading food packer, show they cut cooking time 30%. For example, one operation was shortened from 65 to 45 minutes. Nicholson units keep equipment full of live steam because: 1) they operate on lowest temperature differential; 2) have 2 to 6 times average drainage capacity. Also widely specified for preventing damage to thin gauges; eliminate cold blow in unit heaters; record low for steam waste; and maximum air-venting capacity. 5 types for every application; size ¼" to 2"; pressure to 225 lbs. BULLETIN 1047.

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Hermetic Seals

A 16-page catalog covers both standard and custom designed hermetic seals and features multi-point plugs and multi-headers, high voltage terminals and solutions of high altitude and high ambient temperature problems.—*Hermetic Seal Products Co., Inc., 37 South Sixth St., Newark 7, N. J.*

Item 7

Process Heating Oil Burner

A Hauck oil burner intended for industrial heat processing in metallurgical, ceramic, glass, chemical and similar plants is described and illustrated in the 24-page catalog No. 410.—*Hauck Manufacturing Co., 124 Tenth St., Brooklyn 15, N. Y.*

Item 8

Fan Size Standards

As a successor to NAFM Form X12 covering physical proportions of commercial fans, the National Association of Fan Manufacturers has issued Bulletin 105 which collates ten years of market studies of desirable fan size intervals and suggests size standards for multi-blade and non-overloading types of fans. Recommended size standards for other types of fans have also been established for subsequent releases. Form X12 is therefore withdrawn from further distribution. — *National Association of Fan Manufacturers Inc., 2159 Guardian Building, Detroit 26, Mich.*

Item 9

Synchronous Motors

Bracket bearing type AB Allis-Chalmers synchronous motors are described in a 16-page bulletin with starting instructions, installation photographs, cutaway drawings, and rating tables. — *Allis-Chalmers, Milwaukee 1, Wis.*

Item 10

Steel Equipment

Red Tiger steel equipment for stock handling, small parts assembly, transfer, and storage, as well as office equipment and steel files, is described and illustrated in catalog 110 which features a free advisory service on problems involving use of steel equipment. — *Red Tiger Products, Inc., 20 N. Wacker Drive, Chicago 6, Ill.*

Item 11

Impulse Timer

The Zenith model RT impulse timer, which provides impulse circuits for elevator starting, production line control, pilot circuits and on-off circuits for fans and other appliances, is described in a 4-page illustrated folder.—*Zenith Electric Co., 152 W. Walton St., Chicago 10, Ill.*

Item 12

Heating Boilers

Catalog No. 561 illustrates and describes the "100" Series boilers. These are made in Type A for automatic firing with gas or oil, and in Type H for hand firing. These boilers, for use with either steam or hot water heating systems, are designed for installation in the limited space usually provided in the smaller home.

Catalog No. 562 is devoted to the "200" Series boilers in Types A and H. These larger boilers, for use with either steam or hot water, are sized for the larger home or for commercial buildings. While completely equipped for hand firing, the "200" boilers may also be converted to automatic firing when desired. — *The National Radiator Co., Johnstown, Pa.*

Item 13

Home Heating Equipment

A 20-page, 2-color catalog, No. A645B, describes the Coleman line of automatic heating equipment for residences, including oil and gas fired warm air furnaces, floor furnaces, wall heaters, and water heaters.—*The Coleman Co., Wichita, Kan.*

Item 14

Strainers

Yarway bulletin S-202 covers strainers for piping installations with tables of pressure and screen data. Special attention to design of screens is featured and both Dutch weave and perforated screens are offered. —*Yarnall-Waring Company, Mermaid Lane, Philadelphia 18, Pa.*

Item 15

Temperature Regulators

A 6-page folder describes construction and operation of Spence Type E2T100 temperature regulator. Illustrations show how regulator is adapted for storage and instantaneous water heaters by varying steam pressure with small temperature changes at the thermostat.—*Spence Engineering Co., Inc., Walden, N. Y.*

Item 16

JANUARY, 1950

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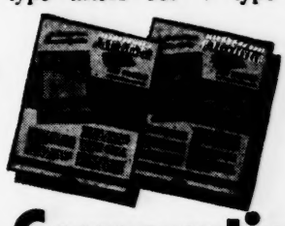

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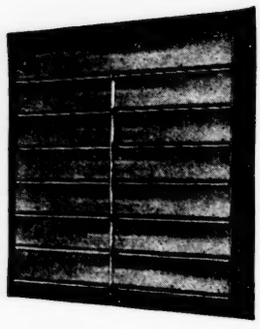

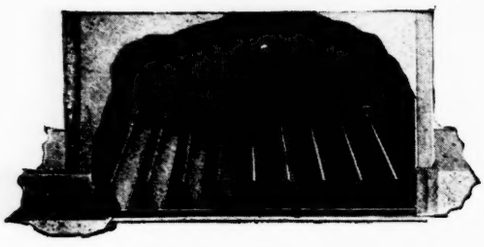

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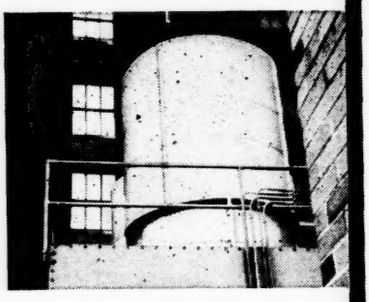

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. . . Since the Last Issue

John G. Bergdoll, Jr., vice president and works manager of **York Corp.**, was elected president of the American Society of Refrigerating Engineers at the annual election of the organization held December 7, at the Edgewater Beach Hotel in Chicago.

R. F. DeLay

Robert F. DeLay has been named manager of advertising and sales promotion for the **Herman Nelson Corp.**, Moline, Ill., manufacturer of heating and ventilating equipment. In this capacity Mr. DeLay will coordinate the advertising and promotion activities of all Herman Nelson divisions, including merchandised products, engineered products, portable products and unit ventilators. Mr. DeLay was formerly advertising manager for the Victor Animatograph Corp., Davenport, Iowa. Prior to the war Mr. DeLay graduated from South Dakota State College with a B.S. degree in journalism and advertising.

David Innes, former manager of **Owens-Illinois Glass Co.'s** Kaylo Division plant in Sayreville, N. J., has been named product development engineer. Mr. Innes will carry on his new work in connection with the sa'es department in Toledo, Ohio. He is being replaced in Sayreville by **O. W. Pfeiffer.**

Richmond Radiator Co. has announced the e'ection of **Cecil W. Farrar** as vice president and general manager of sales; and **F. B. Mahoney** as vice president and general manager of manufacturing. Formerly president of the Excelso Products Corp., Mr. Farrar joined Richmond as sales manager of the plumbing division in September 1945. In March of 1948, he was appointed director of sales promotion for all Richmond products. Mr. Mahoney joined Richmond as general factory manager in 1944. Prior to that time, he was vice president in charge of production for the Ellwood Co., and previously was vice president and director of manufacturing for the Humphreys Manufacturing Co. at Mansfield, Ohio.

Harold E. Pembrook, formerly sales manager, Stewart Manufacturing Co., Inc., has been appointed sales manager, refrigerated storage division of the **W. B. Connor Engineering Corp.**, manufacturers of activated carbon air purification equipment.

The appointment of **A. M. Shaw** as assistant manager, pump and compressor merchandising division, has been announced by **Worthington Pump and Machinery Corp.**

E. A. Booth

The National Supply Co. has announced the appointment of **Edwin A. Booth** as general manager of sales of the Spang-Chalfant Division of the company. He has been a member of the National Supply organization since 1929. Born in Pittsburgh, Pa., Mr. Booth attended schools there and Pennsylvania State College, where he received a degree in mechanical engineering. Upon graduation, he entered the metallurgical department of Spang-Chalfant, and two years later was transferred to sales. After sales department experience in Pittsburgh and St. Louis, he was appointed manager of the Tulsa district in 1942, returning to Pittsburgh four years later in a similar capacity.

Leo F. Brown has been appointed plant manager of the air conditioning equipment plant of the **General Electric Co.'s** Air Conditioning Department.

Baker Refrigeration Corp., at South Windham, has announced the election of **Frederick W. Smith** to the position of vice president in charge of sales. Mr. Smith is a native New Englander. He was born in Somerville, Mass., and attended Dartmouth College. He did postgraduate work at Amos Tuck School of Business Administration. For the past five years, Mr. Smith has been products manager of merchandising equipment of Carrier Corp. at Syracuse, New York.

Gas Appliance Manufacturers Association, with headquarters in New York City expanded the activities of its Washington office, effective January 1, 1950. **Leonard Macomber,** GAMA Washington representative since 1943 has retired and **James R. Lee** has been appointed as Washington representative for the association with offices at 731 National Press Building, Washington, D. C.

Ralph S. Penn and **E. B. Maire** have been elected vice presidents of **Penn Electric Switch Co.**, Goshen, Ind. Ralph S. Penn has been active in the company since 1937 and has served as manager of several of the company's district offices. E. B. Maire joined the Penn Company in 1934 and for several years managed the company's district office in Chicago.

F. Kaiser

Creation of a new management sales post and promotions of four branch and regional managers have been announced by the **Minneapolis-Honeywell Regulator Co. Fred Kaiser,** midwest regional manager for the company since 1942, has been promoted to field sales manager. **Clarence L. Peterson,** who has been Pacific regional manager for Honeywell with offices in San Francisco, will succeed Mr. Kaiser in the midwest area. Mr. Kaiser's position as field sales manager is new to the company. It was created to coordinate the increasing activities of the field organization which now encompasses 77 branch and regional offices within the United States. Succeeding Mr. Peterson as Pacific regional manager is **Gavin S. Younkin,** who has been Honeywell's Los Angeles branch manager since 1943. Mr. Younkin will continue to headquarter in Los Angeles and direct the region from that office. **Reginald C. Cushing** has been promoted to branch manager of the company's San Francisco office. He joined the Honeywell organization in 1935. In 1946 he was made regional air conditioning sales manager, a position he held until his latest promotion.

Jonas H. Ingram, Admiral U. S. Navy, retired, has become associated with **Reynolds Metals Co.,** as executive representative. Admiral Ingram was commander-in-chief of the Atlantic fleet at the close of World War II, where his service in that important role climaxed a brilliant naval career of 44 years duration. He was graduated from the U. S. Naval Academy at Annapolis in 1907 and retired in 1947.

Automatic Firing Corp., St. Louis, announces the election of **James J. Lee** as vice president of the company. Mr. Lee has served as sales manager since 1945, following his return from the U. S. Navy. Prior to his entrance into the service he had been associated with the St. Louis Board of Education and the Firestone Rubber Co.

Raymond K. Serfass has been named assistant general sales manager of the **York Corp.** Mr. Serfass steps into his new position from that of industrial sales manager of the North Atlantic District of the corporation, with headquarters in New York, a position he has held since 1945. Mr. Serfass was succeeded as industrial sales manager of the North Atlantic District by the promotion of **Alvin N. Barnes, Jr.,** a veteran sales engineer, who has been with the York firm for nearly 30 years.

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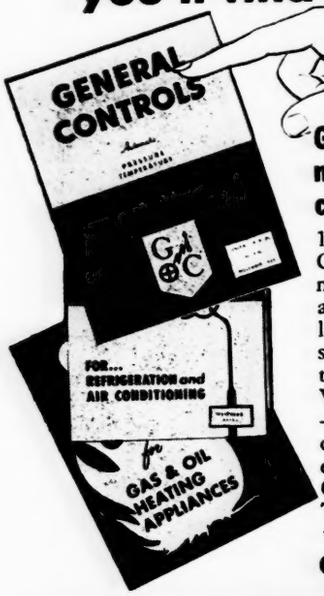

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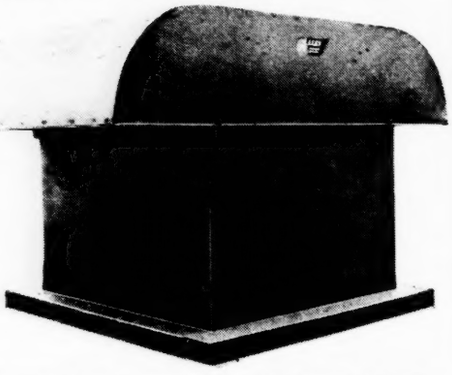

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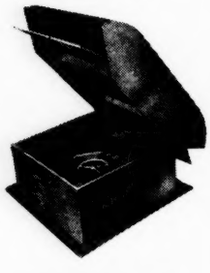

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W. M. Barber

Walter M. Barber has been appointed sales promotion and advertising manager of **Perfection Stove Co.**, a newly created post. Since early 1942 Mr. Barber has been manager of Perfection's Cleveland district sales office. He first came to the company in 1915, to engage in sales promotion work. In 1917 he was named manager of the company's St. Louis, Mo., district sales office. In 1919 he went to Europe to act for Perfection Stove Co. In 1924, following several years residence abroad, Mr. Barber took a trip around the world, from New Zealand to northern Manchuria, as a representative of his company. He introduced the Perfection name and products into such countries as India, Arabia, Palestine and Egypt.

Following his trip around the world, Mr. Barber was recalled to the United States and organized the company's Philadelphia, Pa., branch, which he managed for two years. In 1929 he was named to head the then new Superfex oil-burning refrigerator division.

L. I. Stead of East Chicago has been appointed chief chemist for Chicago district plants of **The Youngstown Sheet and Tube Co.** He succeeds Herbert McComb who died recently.

William W. Martenis has been appointed manager of sales engineering of the **Minneapolis-Honeywell Regulator Co.** In the newly created post, Mr. Martenis will assist in planning specifications, approve new developments and coordinate activity between the sales and engineering departments of the company. Mr. Martenis is a native of Minneapolis and a graduate of the University of Minnesota where he received bachelor's and master's degrees in engineering. He joined Honeywell in 1931.

Albert A. Criqui, 67, of 39 St. John's Ave., Kenmore, consulting engineer for the **Buffalo Forge Co.**, died suddenly November 7th, 1949. Mr. Criqui was born at Harris Hill, March 3, 1887. He attended schools in Cheektowaga and was graduated from Canisius High School and Canisius College. His entire engineering career was spent with the Buffalo Forge Company. He began there in 1903 and in 1915 became chief engineer, a position he held until 1948. He was the holder of 12 patents on high speed centrifugal fans.

The appointment of **Edward D. Kemble** as plant manager of the automatic heating division of the **General Electric Co.'s** Air Conditioning Department has been announced recently.

Getting Personal

A. M. Hanfmann

Alexander M. Hanfmann *(Designing for Air Purity*, page 59), graduated from the Altenburg Engineering College (Germany), in 1930, as an electrical engineer. In 1939 he came to this country and studied communications at Massachusetts Institute of Technology.

He became associated with the Westinghouse Electric Corp. at their Springfield, Mass., plant in 1940, in the manufacture of air conditioning equipment. Since that time he started combining air conditioning and ventilating work with his electrical back-

ground. He took a number of extension courses in air conditioning at Massachusetts University and Columbia Graduate School of Engineering.

In 1941 he worked on power station design for Stone & Webster Engineering Corp., Boston, Mass. Mr. Hanfmann joined the Factory Planning Department of the Western Electric Co. electronic shops in New York and the following year was assigned to the planning of the new Allentown plant. After the completion of the plant in 1948 he became a product engineer for the company.

F. G. Hamburger

Fred G. Hamburger *(Conditioning of Airport Facilities*, page 75) is a native of New York City and graduated from New York University in 1933 with a Bachelor's Degree in Mechanical Engineering. After engineering experience in the chemical and food industries he was engaged on the Manhattan Project during the war and has since been employed as mechanical engineer and project coordinator by Guy B. Panero. His specialty is consultation in air conditioning, power plants and ventilation. He is a licensed professional engineer in New York State.

A. A. Giannini

A. A. Giannini *(Absorption Refrigeration Applied for Air Conditioning Offices*, page 65) received his B.S. in M.E. from New York University in 1933 and his M.E. from the same university in 1942.

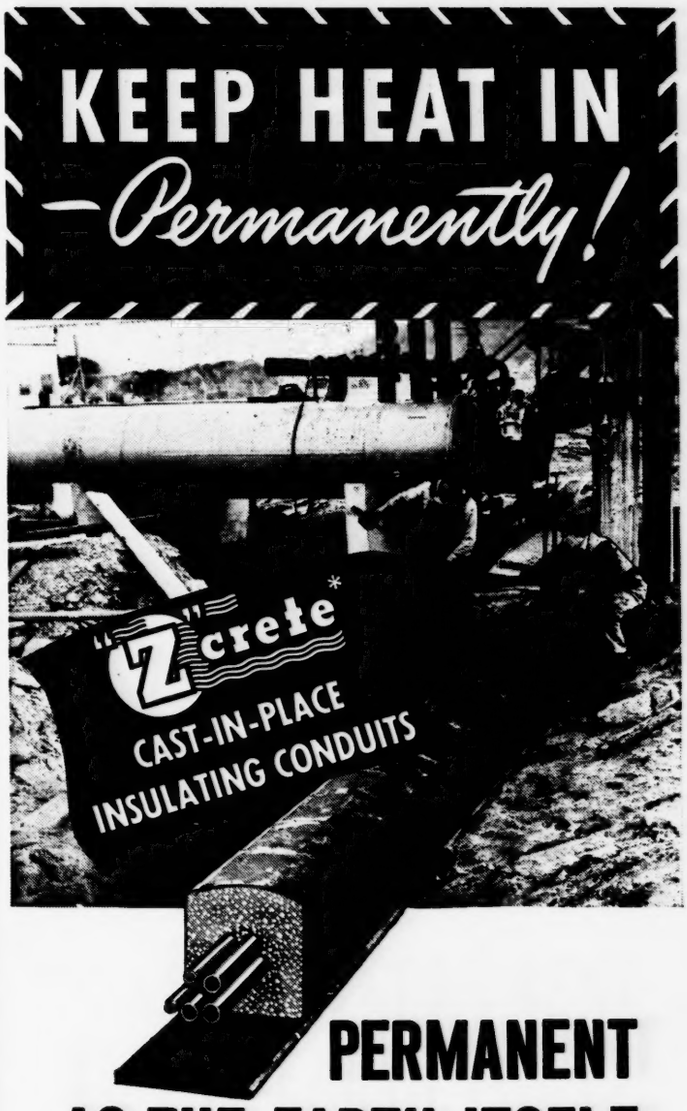
From 1933-36 he was gas utilization engineer with the Consolidated Gas Co. For the next four years he was with the Bryant Air Conditioning Co. as air conditioning sales engineer. In 1940 he joined the Carrier Corp., and has been with them since.

Mr. Giannini taught air conditioning in the evening at the Brooklyn Technical High School, for the period 1937-41. From 1945 to the present, he has served as instructor, New York University, Division of General Education.

He is the author of a number of articles that have been published in technical publications.

INDUSTRIAL DEGREE-DAYS
November, 1949

City	55F Base	45F Base
Baltimore, Md.	225	56
Buffalo, N. Y.	513	247
Chicago, Ill.	390	160
Cleveland, Ohio	422	184
Detroit, Mich.	486	241
Indianapolis, Ind.	410	171
New York, N. Y.	273	85
Philadelphia, Pa.	264	80
Pittsburgh, Pa.	347	121
St. Louis, Mo.	226	57



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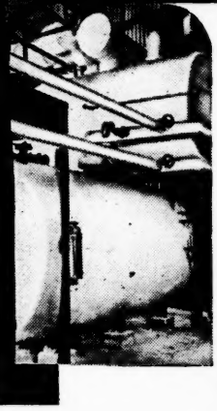

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Canadian Degree-Days for November, 1949*

City	November		Cumulative Sept. 1 to Nov. 30	
	1949	Normal	1949	Normal
Calgary, Alta.	726	1122	1886	2276
Charlottetown, P.E.I.	882	858	1591	1619
Crescent Valley, B. C.	813	981	1925	2039
Edmonton, Alta.	840	1215	2055	2406
Fort William, Ont.	1137	1143	2219	2219
Grande Prairie, Alta.	864	1218	2109	2510
Halifax, N. S.	714	789	1292	1477
London, Ont.	918	843	1547	1477
Medicine Hat, Alta.	666	1104	1632	1972
Moncton, N. B.	969	936	1737	1813
Montreal, P. Q.	1024	948	1669	1689
North Bay, Ont.	1188	1017	2118	1975
Ottawa, Ont.	1071	984	1793	1783
Penticton, B. C.	696	813	1546	1553
Porquis Junction, Ont.	1341	1266	2429	2462
Prince George, B. C.	810	1068	2097	2253
Quebec City, P. Q.	1083	1050	1787	1977
Regina, Sask.	948	1355	2184	2557
St. John, N. B.	885	870	1539	1698
Saskatoon, Sask.	954	1305	2203	2482
Toronto, Ont.	839	817	1363	1489
Vancouver, B. C.	516	657	1263	1350
Victoria, B. C.	471	462	1156	1172
Windsor, Ont.	783	795	1248	1274
Winnipeg, Man.	1038	1302	2120	2376

*These data are supplied through the courtesy of the Meteorological Division, Air Service Branch, Department of Transport, Canada.

COMING EVENTS

Where listed, names or titles of individuals are those from whom further information is available.

HEATING AND VENTILATING MEETING—56th annual meeting of the American Society of Heating and Ventilating Engineers, at Dallas, Tex. A. V. Hutchinson, secretary, 51 Madison Ave., New York 10, N. Y. ....**JANUARY 23-26, 1950.**

HEATING AND VENTILATING SHOW—Southwest Air Conditioning Exposition of the International Heating and Ventilating Exposition, State Fair Grounds, Dallas, Texas, under the auspices of the American Society of Heating and Ventilating Engineers. Charles F. Roth, manager of the International Exposition Company, Grand Central Palace, New York 17, N. Y. .....**JANUARY 23-27, 1950.**

AIEE HOUSE HEATING CONFERENCE—A technical conference on electric heating of houses and heat pumps, sponsored by Domestic and Commercial Applications Committee of the American Institute of Electrical Engineers, at Hotel Statler, New York, N. Y. R. S. Gardner, assistant to the secretary, 33 W. 39th St., New York 18, N. Y. .....**FEBRUARY 3, 1950.**

ENGINEERING SOCIETIES EXPOSITION—5th annual engineering exposition of the Minnesota Federation of Engineering Societies, at Minneapolis Armory, Minneapolis, Minn. Show manager, Brede Inc., 1720 New Brighton Blvd., Minneapolis 13, Minn. .....**FEBRUARY 21-23, 1950.**

CONTRACTORS CONVENTION—1950 convention of The Associated General Contractors of America, Inc., at San Francisco, Calif. Wm. G. Dooly, Jr., staff member, Munsey Building, Washington 4, D. C. .....**FEBRUARY 27-MARCH 2, 1950.**

MATERIALS MEETING—Spring meeting of the American Society for Testing Materials, at Hotel William Penn, Pittsburgh, Pa. Secretary of Society, 1916 Race St., Philadelphia 3, Pa. .....**FEBRUARY 27-MARCH 3, 1950.**

CORROSION ENGINEERS CONFERENCE—6th annual conference of the National Association of Corrosion Engineers, at St. Louis, Mo. Secretary of Association, 919 Milam Bldg., Houston 2, Tex. .....**APRIL 4-7, 1950.**

POWER CONFERENCE—12th annual Midwest Power Conference, sponsored by Illinois Institute of Technology, at Hotel Sherman, Chicago. Conference director, Roland A. Budenholzer, at Illinois Tech, 3300 S. Federal St., Chicago 16, Ill. .....**APRIL 5-7, 1950.**

ASME MEETING—Spring meeting of the American Society of Mechanical Engineers, at Hotel Statler, Washington, D. C. C. E. Davies, secretary, 29 W. 39th St., New York 18, N. Y. .....**APRIL 12-14, 1950.**

OIL HEAT EXPOSITION — National Oil Heat Exposition, in conjunction with the 27th annual convention of Oil-Heat Institute of America, at Commercial Museum, Philadelphia, Pa. C. F. Curtin, secretary, 6 E. 39th St., New York 16, N. Y. .....**WEEK OF APRIL 24, 1950.**

PROCESS INDUSTRIES CONFERENCE—Process Industries Division Conference of the American Society of Mechanical Engineers, at William Penn Hotel, Pittsburgh, Pa. C. E. Davies, secretary, 29 W. 39th St., New York 18, N. Y. .....**APRIL 24-26, 1950.**

SHEET METAL CONVENTION—Annual convention of Sheet Metal Contractors Association of Illinois, Inc., at State Armory Building, Springfield, Ill. Geo. L. Folkers, convention chairman, 709 S. Adams St., Peoria, Ill. .....**APRIL 27-29, 1950.**

CONTRACTORS MEETING—1950 annual meeting of the Heating, Piping, and Air Conditioning Contractors National Association, at St. Francis Hotel, San Francisco, Calif. Secretary of Association, 1250 Avenue of the Americas, New York 20, N. Y. .....**MAY 8-12, 1950.**

NDHA MEETING — 41st annual meeting, National District Heating Association, at Grove Park Inn, Asheville, N. C. John F. Collins, Jr., secretary of Association, 827 N. Euclid Ave., Pittsburgh 6, Pa. .....**MAY 23-26, 1950.**

ASRE MEETING—Spring convention of the American Society of Refrigerating Engineers, at Hotel Muehleback, Kansas City, Mo. M. C. Turpin, secretary, 40 W. 40th St., New York 18, N. Y. .....**JUNE 4-7, 1950.**

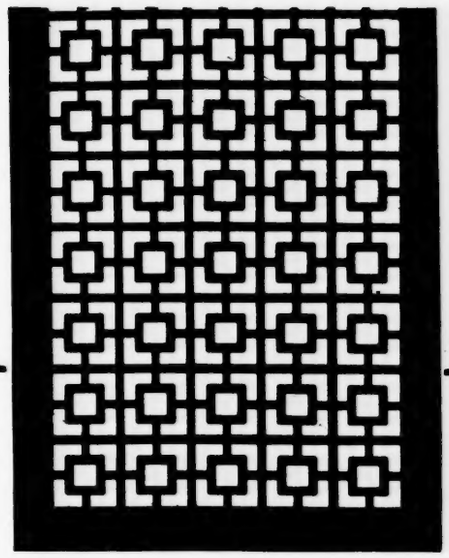
ASME MEETING—Semi-annual meeting of the American Society of Mechanical Engineers, at Hotel Statler, St. Louis, Mo. C. E. Davies, secretary, 29 W. 39th St., New York 18, N. Y. .....**JUNE 19-23, 1950.**

PETROLEUM CONFERENCE—Petroleum Mechanical Engineering Conference at Hotel Roosevelt, New Orleans, La. Secretary, American Petroleum Institute, 50 W. 50th St., New York, N. Y. .....**SEPTEMBER 25-27, 1950.**

AGA CONVENTION—1950 annual convention, American Gas Association, in Atlantic City, N. J. For details, contact secretary, AGA, 420 Lexington Ave., New York 17, N. Y. .....**OCTOBER 2-6, 1950.**

ASRE MEETING—Annual convention of the American Society of Refrigerating Engineers, at Hotel Commodore, New York. M. C. Turpin, secretary, 40 W. 40th St., New York 18, N. Y. .....**DECEMBER 3-6, 1950.**

REFRIGERATION SHOW—7th All-Industry Refrigeration and Air Conditioning Exposition, at Navy Pier, Chicago, Ill. Show director, REMA, 1107 Clark Bldg., Pittsburgh 22, Pa. .....**NOVEMBER 1951.**



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